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PLANNED INTERNATIONAL ECONOMICS

THE high position of the annual reports of the Director of the International Labour Office among current reviews of the industrial and economic condition of the world has been earned only in part by the large resources of knowledge upon which they can draw. It is equally due to their wide outlook, measured but unequivocal judgment and their lucid estimate of tendencies and conditions, free from excessive detail of the work of the organization. These are largely due to personal qualities, and it is indeed a high tribute to Mr. J. E. Winant that his first annual report so admirably maintains the high standard set by his predecessors*. The fact that this report was published before the outbreak of war in no way lessens its present value.

Under the title "The World of Industry and Labour 1939", Mr. Winant reviews in succession the economic setting, the conditions of work and the standards of life. He emphasizes the way in which research and discussions on business cycle policy have led to general agreement that, whatever the initial cause of a business decline, active steps can be taken to prevent the secondary effects which used inevitably to follow it, and that this can be achieved by maintaining consumers' demand and by well-prepared public investment to replace rapidly any decline in private investment. This new attitude is conspicuous in the United States, and economic policy in Great Britain has shown similar features. While, however, the recession of 1937–38 presented mainly a problem of getting unemployed people back to work, the general concentration on problems of national defence has given a new turn to the economic situation. In this situation the urgency of meeting essential needs of national defence tends to cut into the standards of living, which it is the work of the International Labour Organisation to endeavour to raise.

To minimize such an effect it is first desirable to increase armament production so far as possible by utilizing unemployed resources, so as not to disturb ordinary peace-time activities more than necessary. Secondly, when it is necessary to restrict other types of activity or production, care should be taken to confine such restriction to the minimum and to those fields which least jeopardize present and future standards of living. While both public spending designed as a recovery measure and expenditure on armaments cause an initial increase in activity, the latter must be accompanied by measures to prevent expansion of consumption and a rise in standards of living.

These threats to established standards and the growing pressure on resources accentuate the importance of international economic co-operation. The rising standard of living in modern times has been made possible by the expansion of markets and the world-wide exchange of raw materials, finished products and capital investment. The hope of further progress rests on the continuance of this process.

The main problem is always to organize world economy in a way that will utilize fully the capacities of mankind in the production of the goods and services needed to raise the standard of life. Mr. Winant's survey of conditions of work indicates how true this is of internal economy also. Political conditions have been the main factor determining the check on the movement for shorter hours and the hesitation in giving effect to

*The World of Industry and Labour, 1939. International Labour Office. Report of the Director. (Geneva: International Labour Office. 2s.).

the application of the principle of the forty-hour week adopted by the Conference in 1935. This remains, however, a permanent problem of social and economic policy, and the realization of shorter working hours is one of the great additional benefits that will be assured when nations will agree to a just and lasting peace.

There are, however, directions in which progress has been made. The development and extension of social insurance and the widespread attention being given to problems of nutrition, whether from the scientific side or in Government efforts to raise the level of nutrition by means of education and publicity, are noteworthy examples. Housing also is a matter in which the State is taking a more active part.

What is of special interest in Mr. Winant's survey is the way in which he indicates the extent to which solutions of these problems were being attempted in many countries, and frequently by very similar methods, however different the objectives or main character of policy. This is scarcely less striking than the equally emphatic conclusion that success in this matter of improving standards of health and labour and living conditions can only be imperfectly achieved except through co-operation between the nations.

This report is, however, of further interest for the admirable review of the twenty years' work which has now been completed by the International Labour Office. This record of development as well as of achievement is a welcome reminder of the value of international co-operation. The continuous constructive effort by which the International Labour Conference has developed its technique is at least as impressive as the record of its achievement in establishing an international labour code and in assisting the organization and co-ordination of social policy on which the improvement in living and working conditions depends. The work of the Conference on Migration for Settlement and of the International Public Works Committee are striking illustrations of the latter tendency in the last two years.

Besides this, the International Labour Office has functioned as an international clearing-house of information on labour and social questions. All these activities are based on its research work, and this possesses two special advantages. In its research work the International Labour Office must of necessity use the method of international comparison. The comparative method is to the student of social science what the laboratory is to the physicist. The Office cannot make experiments, but it is able to study the same phenomena in many different countries and thus eliminate what is accidental in the experience of any particular country and emphasize those things which are fundamental to all. Further, the International Labour Office is well placed for bridging the gulf between theory and action by bringing the conclusions reached directly before those capable of acting upon them.

Such research work, coupled with the broad view and tripartite character of the International Labour Office which naturally follow from its constitution, have already assisted it, in such fields as economic depression and unemployment, or in that of industrial diseases, like silicosis, or the standardization of labour statistics and improvement of their comparability, to guide world opinion towards more effective methods.

The extent to which the International Labour Office has succeeded in the last twenty years in furthering steady social progress is at least reason for not losing confidence or hope. The full contribution of the Office to effective international collaboration is not to be measured only by such activities. In approaching labour and social problems, we are forced to face the economic consequence of war and peace, whether in relation to trade conflict or war economy. When the present war comes to an end, the countries of the world will have to face the tremendous problems of readjustment to a peace-time economy. Economic re-employment problems will demand urgent solution. Some means of absorbing workers thrown out of employment by the slowing down of armament production will have to be devised.

In facing such difficulties the International Labour Office already possesses resources of immense value, but if it is to render the greatest possible service its energies must be directed now to the problems that lie ahead. The research work required must be commenced in this period of tension and uncertainties if we are to ensure that the mistakes of the past are not to be repeated. It is on this fact as well as on the proved value of the Organisation that Mr. Winant bases his appeal for financial support and for the resources which will enable it to function effectively. The extent to which the services of scientific workers are being enlisted at the present time should not lead them to overlook their responsibilities for participation in the constructive work of thinking out and planning the implications of a real peace.

THE SCIENTIFIC STUDY OF SOCIETY

The Study of Society

Methods and Problems. Edited by F. C. Bartlett, M. Ginsberg, E. J. Lindgren and R. H. Thouless. Pp. xii+498. (London: Kegan Paul and Co., Ltd., 1939.) 10*s.* 6*d.* net.

SINCE the autumn of 1935, a competent group of British psychologists, anthropologists and sociologists, ultimately twenty-three in number, has been meeting twice yearly in discussion. This unique, invaluable book, comprising nineteen chapters written by seventeen members of the group, is the outcome of their deliberations. Each chapter, we are told in the preface, "was first written by the group member whose name appears at its head. It was then duplicated and sent to all the other group members, so that it could be criticized and discussed at the next meeting of the group. . . . The criticism has been free and often drastic, but mainly constructive. Every member of the group has played a part in this discussion, and the volume is thus, in a literal sense, a co-operative product."

The purpose of the book, the preface explains, is to offer guidance to would-be investigators of social problems who "ask 'What shall we do?' and 'How shall we do it?' . . ." The preface further states that "the idea which inspired the preparation of the present book" was to issue for the benefit of prospective workers in the field of complex societies a companion volume to the well-known "Notes and Queries on Anthropology", first published in 1874, the aim of which was "to promote accurate anthropological observation on the part of travellers and to enable those who are not anthropologists themselves to supply the information which is wanted for the scientific study of anthropology at home".

Prof. F. C. Bartlett, in his important, but admittedly difficult, chapter on "Suggestions for Research in Social Psychology", addressed mainly to the laboratory psychologist, has no doubt as to the value of the contributions which the untrained worker can make to the subject (p. 25); and this view is supported, although with less enthusiasm, by Dr. R. H. Thouless (pp. 126, 127) in his carefully written contribution, "Scientific Method and the Use of Statistics". Prof. Bartlett lightens the last three pages of his article by devoting them to the amateur investigator, giving him eight useful hints and cautions, and eight promising themes of research. But in the rest of the book, save in Dr. Nadel's contribution, "The Interview Technique in Social Anthropology", which makes several references to "Notes and Queries in Anthropology", the practical interests and limitations of the untrained worker are largely ignored.

The nineteen chapters of this book are written with a quite unusual degree and uniformity of ability. They vary widely in length from the seven pages of Mr. E. Farmer's too meagre article on "The Study of Social Groups in Industry" to the fifty-two pages of Dr. E. J. Lindgren's article on "The Collection and Analysis of Folk-lore", which, like Prof. M. Ginsberg's deeply philosophical and learned chapter on "The Problems and Methods of Sociology", would rank as a 'classic' had it appeared in an encyclopædia, but is only to be grasped thoroughly by an advanced student of the subject. Less excusable is the surprising latitude which has been allowed to each member of the group in the mode of treatment of his subject. Stricter and single leadership of the group would have resulted in greater formal homogeneity and in a closer adherence to the three cardinal objects of the book: description of methods, summary of results already achieved, and mention of the outstanding problems at present most deserving of attack.

The failure of certain contributors to fulfil these objects is due to different, and sometimes excusable, causes. For example, Prof. T. H. Pear's chapter on "Some Problems and Topics of Contemporary Social Psychology" covers far too many topics: it is necessarily diffuse and superficial and appears at first sight popular and at times even trivial, but a second reading reveals considerable thoughtfulness in its preparation. On the other hand, the very subject of Dr. J. T. MacCurdy's interesting, though provocative, chapter on "The Relation of Psychopathology to Social Psychology" precludes much reference to past results and future problems. Again, Dr. Audrey Richards's contribution, "The Development of Field Work Methods in Social Anthropology", which is a veritable mine of information, thoughtfully and practically presented, and containing more than a hundred and twenty references, deals, as perhaps its title justifies, only with methods, not with results; and in her chapter on "Modern Trends in Child Psychology", Dr. Mary Collins makes virtually no attempt to indicate to the future investigator what are the most pressing problems that demand study. Indeed, this is scarcely to be expected after the impression, produced on her by her survey, "of a somewhat

disordered array of experimental and test results, statistics and minute observations. It is often difficult to understand with what aim a particular investigation has been undertaken, or what importance should be assigned to the conclusions which are claimed to be established" (p. 85). Perhaps the most stimulating chapter for the quite untrained worker is that contributed by Miss Clement Brown on "The Methods of Social Case Workers", obviously the product of mature and wide experience and of unusual wisdom; while for the general reader Mr. A. Rodger's succinct but excellent chapter on "The Work of the Vocational Adviser" could not be bettered.

So many excellent articles—some of them (especially those by Prof. Bartlett, Prof. Ginsberg, Dr. Lindgren and Dr. Richards) brilliant—deserve to have been presented in a more attractive *format*, on pages with ampler margins and less crowded with type. This might, in the reviewer's opinion, have been achieved by the omission of the subjects of certain chapters, for example, those on intelligence tests, attitude tests, rating scales and the use of statistics, which are scarcely suitable for such a volume as this or have already been at least as adequately treated elsewhere. Dr. C. J. C. Earl's contribution, "Some Methods of Assessing Temperament and Personality", written from the clinical point of view, a last-moment substitute for an article by Dr. R. B. Cattell who, owing to his departure for the United States, was unable to preserve his membership of the group, seems also scarcely suitable; and Dr. O. A. Oeser's contribution, disappointing in the scanty information it provides of the Dundee Survey of which he was in charge, might have been more briefly included in Mr. A. F. Wells's chapter on "Social Surveys".

"The first aim," claims the preface, "which the group has set itself is achieved." This is undeniably true. Nowhere will the reader find so complete, so reliable, so illuminating and so critical an account of the methods of psychology, anthropology and sociology applied to the study of the problems of complex—and primitive—societies. Only by the wise use of such methods can man come to a final understanding of the social factors that determine harmony and conflict between groups and nations.

COMMERCIAL DEVELOPMENT OF AFRICA

Capital Investment in Africa

Its Course and Effects. By Prof. S. Herbert Frankel. (Issued by the Committee of the African Research Survey under the auspices of the Royal Institute of International Affairs.) Pp. xvi + 487. (London, New York and Toronto: Oxford University Press, 1938.) 10*s*. 6*d*. net.

WHEN Lord Hailey was formulating the plans for the African Research Survey, Prof. S. H. Frankel was asked to prepare a memorandum on the course of capital investment in Africa. At the time, he doubted whether it would be possible to gather sufficient information in the time available, but eventually he undertook the task. Soon the study outgrew its modest origin and has consequently been published as a separate volume. The work is very fully documented and has more than a hundred detailed tables as well as a number of graphs, but the innumerable footnotes make the book a difficult one to read, more especially as many of the footnotes form really an essential part of the text.

For centuries Africa south of the Sahara played but little part in world economy. Africans had little to offer and as little to demand from traders, and hence came the slave trade—a trade which automatically destroys all others. Even the temperate lands of South Africa were regarded only as important in guarding the routes to India. The change came with the discovery of minerals in South Africa, and in a single generation European powers established sovereignty over most of Africa (that is, Africa south of the Sahara, to which the whole work refers). So late as 1878 only a quarter of the continent was occupied by Europeans; now it is the whole, with the exception of Liberia. Prof. Frankel dismisses in a page and a half the natural factors which retarded the 'opening up' of Africa, so that the scientific worker must regard his study as complementary to the main work, Lord Hailey's "An African Survey", and not as complete in itself. Yet such an economic study confirms conclusions based on other grounds.

The task of developing tropical Africa proved beyond the resources of the chartered companies—even though patriotic investors continued to find money without any return for half a generation—with the result that half of the £1,222,000,000 invested in Africa has been invested by Governments or public authorities. Even in the temperate south, the story is one of constant struggle in a land of outposts—until diamonds and then gold brought the economic revolution to South Africa. The value of diamonds produced in the Union has exceeded £320,000,000; £80,000,000 has been

paid in dividends and from 1911 until 1937 alone the Union Government received nearly £33,000,000 in taxation from the industry. That the Government revenue fluctuated from more than £4¼ millions in 1929 to less than £150,000 in 1916 or £350,000 in 1934 presents another side of the picture. Despite the very successful development of the world's greatest gold field, it is estimated that the net returns on capital in Rand investments is only 4·1 per cent.

In recent years, as British investments in foreign countries have decreased, the proportion devoted to African issues has increased to about a quarter of the total foreign issues made in London. In this connexion Tables 46–48 are particularly interesting. No less than 77 per cent of the total capital invested in Africa is in British territories (with 85 per cent of the total trade). The Union of South Africa has received 43 per cent of the total capital and has 55 per cent of the total trade (1935). In the general position, there has been extraordinarily little change in the last thirty years so far as the relative position of British and French territories are concerned, but from 1907 until 1935 the share in the trade of the Union decreased from 61 to 55 per cent, whilst East Africa increased from 6·3 to 9·7 per cent. Those countries which show the smallest return, as expressed by value of foreign trade, in proportion to the capital which has been invested, include Tanganyika, South-West Africa, Angola, Mozambique, the Congo and the Cameroons. The best figures are shown by West Africa (Gambia, Sierra Leone, Gold Coast, and the French Territories). These facts give much food for thought, and indeed the whole work is a remarkable commentary on what is known of natural conditions and resources.

L. D. S.

PATHOLOGICAL PROBLEMS OF FRUIT AND HOPS

Diseases of Fruit and Hops

By Dr. H. Wormald. (Agricultural and Horticultural Handbooks). Pp. 290 + 40 plates. (London: Crosby Lockwood and Son, Ltd., 1939). 17*s.* 6*d.* net.

ANY advance in the most important science of plant pathology is soon common knowledge to scientific workers through the medium of scientific papers, but there still remains the necessity of passing on such knowledge to the grower. Authentic and reliable information of this kind must always be of interest and value, but good books appear all too seldom, and in the volume here reviewed it is stated that none has been printed on this particular subject since 1920.

It is therefore pleasant to welcome this account of the "Diseases of Fruit and Hops", written by Dr. Wormald, who has been plant pathologist at the East Malling Fruit Research Station for many years. It is a companion volume to one written some two years ago on insect pests of the same crops by Dr. Massee of the same research station.

There are fifteen chapters, the first three being devoted to approaching the subject in a general way before dealing with the specific diseases. Chapter i opens by discussing the factors which influence the growth of plants for good or ill and so determine whether they will be healthy or otherwise, quite apart from the question of attack by disease organisms. Then follows a description of the types of disease that may occur, bacterial, fungal, or virus, and particular stress is laid on that class of disorder resulting from unfavourable environmental conditions, the so-called 'functional' diseases which hitherto have been somewhat neglected by investigators. General principles for avoiding such troubles are given in some detail. Chapter ii deals with the making and the application of fungicidal sprays, with advice on suitable machines for this work. Chapter iii is taken up with descriptions of about a dozen outstanding diseases, each affecting many kinds of fruit trees, although each is again mentioned under its various hosts.

In the next eleven chapters we find a score of fruit plants and the hop plant dealt with either singly or in groups of similar types of fruits. The arrangement is to group the diseases at the beginning of the chapter, and then for each host in turn to describe the symptoms of the various diseases which may appear on its organs, taken in the order root, stem, leaf and fruit. The intention is to help growers to recognize the symptoms easily and thus identify the cause of the trouble. After each symptomatic description, suitable remedial measures are briefly discussed and in each case a limited number of references to further literature is supplied.

The last Chapter (xv) contains descriptions of several important fruit diseases which have not yet been recorded in Great Britain, some of which are so destructive that it is unnecessary to emphasize the value of such information to growers. The end of the book contains three

indexes, one of popular names, one of scientific names, and one of authors.

The book is up to date and the author has discussed control measures in a practical and simple manner that will be appreciated by growers. The descriptions of symptoms are good on the whole, though the grower may not find these so readable. The author in his preface expresses the hope that the book will be of some interest to students, but in our view these should be catered for in a separate book. It is unlikely that the average grower will appreciate descriptions of microscopic spores or their measurements in microns. We feel that much space occupied by technical detail could have been used to better purpose. In any event, the drawings of microscopic objects on pp. 57, 58, 188, 245 and 266, give no indication of the magnification and might be most misleading. An excellent feature is the provision of forty plates containing no fewer than 130 photographs, but in the case of several diseases the text contains no reference to the appropriate plates.

There are some outstanding omissions. For example, silver leaf disease is fully dealt with but there is no mention of the very common and externally similar appearance known as 'false' silver leaf which may call for very different treatment. Again, when discussing the serious virus disease known as 'yellow edge' of strawberries, little mention is made of those so-called 'carrier' varieties, which, though infected, show no obvious symptoms for a considerable time; yet it must be important for growers to be made aware of the danger of trusting such plants near stocks which may be rapidly destroyed by the virus. In dealing with glasshouse fruit plants there is much more that could have been included, but perhaps this is not of very great importance in a book principally concerned with hardy fruits.

Despite these criticisms, the book should be a very valuable asset to fruit-growers. The diseases have been dealt with in a clear and able fashion by one of the foremost authorities on pathological problems connected with hardy fruit production.

D. E. GREEN.

ANTHOLOGIA ANTHROPOLOGICA

(1) The Native Races of Australasia

Including Australia, New Zealand, Oceania, New Guinea and Indonesia. A Copious Selection of Passages for the Study of Social Anthropology from the Manuscript Notebooks of Sir James George Frazer. Arranged and edited from the MSS. by Robert Angus Downie. (Anthologia Anthropologica.) Pp. vii + 390. (London: Percy Lund, Humphries and Co., Ltd., 1939.) 35*s*. net.

(2) The Native Races of Asia and Europe

A Copious Selection of Passages for the Study of Social Anthropology from the Manuscript Notebooks of Sir James George Frazer. Arranged and edited from the MSS. by Robert Angus Downie. (Anthologia Anthropologica.) Pp. vii + 400. (London: Percy Lund, Humphries and Co., Ltd., 1939.) 35*s*. net.

(1) IN the second volume of extracts from Sir James Frazer's notebooks, the principle of selection remains unchanged. In the main, material which has been used as evidence in his works has been omitted; and preference has been given to early or obscure sources, which would be outside any but an almost exhaustive knowledge of the literature. Hence it has been possible to give due recognition to the careful observation which has been made by Dutch travellers and officials of the natives of Holland's possessions in Indonesia. In these extracts from early travels, or from records appearing in periodicals and publications difficult of access to English readers, much material will be found of the greatest value to the student for the less familiar peoples of Sumatra, Java, Celebes and others of the more remote islands of Indonesia.

Although the records of the natives of the geographical regions covered by this volume—for example, Australia, New Zealand, Melanesia and in a lesser degree Polynesia—are among those most familiar in ethnographical literature, it will nevertheless be found that Mr. Downie's editing has made a most successful gleaning from the less well-known fields; but most welcome among his citations are the extracts from manuscript sources communicated direct to Sir James by their authors. Among these, two in particular require mention—one a note on the existence of totemism in Fiji by the late W. H. R. Rivers, which is an instructive example of his care in inquiry and his cogent method in ethnographical argument; and the second some observations by the late A. W. Howitt on the natives of south-east Australia, which are drawn from an unpublished work by that distinguished Australian anthropologist, and of which Sir James promises early publication.

(2) In this volume of extracts, it will be found that though "The Golden Bough", the "Folklore of the Old Testament", and other of Sir James's works have drawn liberally on the sources, the store is

still far from depleted, and much has remained for inclusion here of interest and of value for the student of magic, ritual and belief. Especially interesting are the extracts from the records of early Catholic missionaries, whether they deal with Tibet, Indo-China, or the Chinese Empire. Among the Tibetan, Chinese and Japanese extracts, especially valuable are those which include some of W. W. Rockhill's less accessible notes; while the records of the Korean and Siberian peoples might well serve as a starting point for a study of 'possession' and shamanism. The extracts from John Richardson's travels in Persia, which deal with a little-known side of Persian traditional belief, the angelic associations of the months, are of noteworthy interest for the study of the developments of magical thought in the East.

It was, perhaps, inevitable that the European material should scarcely lend itself to the treatment, which has proved so favourable in dealing with the records of more primitive peoples. The literature is both too familiar and too extensive. Hence these extracts, by contrast, must seem scrappy. Nevertheless, there is much of interest and value, among the more notable being early accounts of the northern form of witchcraft in Lapland and Scandinavia, with the southern European vampires and witches in contrast, and of the survivals in Central Europe of the worship of pagan deities.

The work of editing these extracts has been carried out by Mr. Downie once more with meticulous care, and he has enhanced their utility by a series of illustrative maps and a comprehensive index.

ARTIFICIAL RADIOACTIVITY

(1) **Atomes, radioactivité, transmutations**
Par Maurice de Broglie. (Bibliothèque de Philosophie scientifique.) Pp. 270. (Paris: Ernest Flammarion, 1939.) 22 francs.

(2) **Künstliche Radioaktivität und ihre kernphysikalischen Grundlagen**
Von Prof. Dr. W. Hanle. Pp. viii+114+7 plates. (Jena: Gustav Fischer, 1939.) 12 gold marks.

(3) **Künstliche Radioaktivität: Experimentelle Ergebnisse**
Von Dr. Kurt Diebner und Dr. Eberhard Grassmann. Pp. xi+87. (Leipzig: S. Hirzel, 1939.) 12 gold marks.

(1) THE first of these books represents one of the most pleasing accounts of the present position of nuclear physics that the reviewer has read. It gives a most up-to-date description of the neutron and its properties, of natural and artificial radioactivity and of the new chemistry of the nucleus, couched in very clear language and eminently suitable for the general reader. At the same time, all important features of modern work in these branches of physics are covered in an extraordinarily complete manner. The work can confidently be recommended to all students, particularly those who wish to improve their knowledge of French.

(2) The second book is also meant for the general reader, but it is rather more restricted in its range of subject-matter. It gives a brief introduction to the fundamental conceptions of the structure of the atom, a description of the elementary particles of modern physics and their role in nuclear structure, and a short but very beautifully illustrated account of the experimental methods used in experiments on nuclear transformations. It is a sad reflection that in recent years Germany has taken so little part in the development of these methods. The book also describes in some detail the various types of nuclear changes and the methods of producing artificial radioactivity, a special section being devoted to γ-radiation. It concludes with a few remarks on possible applications of the results of nuclear physics experiments to chemistry, biology, medicine and technology, and contains a striking series of coloured graphs illustrative of the transformations of natural and artificial radioactive elements.

(3) The third book is really a very valuable set of physical tables. In it are set forth the data on artificial radioactivity published up to September 1938. There is no attempt at describing the methods of experiment or of analysing the results in a critical manner. The work is intended as a reference book for the research worker and the teacher who wishes to know whether a particular nuclear reaction has been studied, and so on. A list of nearly 350 references is given, and in addition to a full analysis of the separate nuclear reactions for each element under such headings as artificial radioactivity produced by α-rays, artificial radioactivity produced by protons, etc., the data is also set forth in tabular form. A very large coloured diagram or graph of the stable and radioactive isotopes is included.

L. F. BATES.

ENGINEERING BIOGRAPHY

Great Engineers

By Prof. C. Matschoss. Translated by Dr. H. Stafford Hatfield. Pp. xi+381. (London: G. Bell and Sons, Ltd., 1939.) 12*s*. 6*d*. net.

IN this entertaining volume of biographical studies of some forty mechanical engineers, mainly German and British, the last notice is of Oskar von Miller (1855–1934) who on his seventieth birthday, May 7, 1925, had the satisfaction of witnessing the opening of the "German Museum of Masterpieces of Science and Technology", otherwise known as the Deutsches Museum or the Munich Science Museum. As a young man Miller had visited Woodcroft's Patent Office Museum at South Kensington, and the Conservatoire des Arts et Metiérs in Paris, and had been impressed with the thought that no such museum existed in Germany. After a successful career as an engineer his thoughts again turned to the question of a technical museum for his native land, and in 1903 he was able to found a society for the promotion of such an institution. To this object he devoted his time and energy unstintingly and with great success. Germany now has a museum worthy of her own great contributions to industrial enterprise, and representive of mechanical progress throughout the world.

In the task of familiarizing German students with the work of the great pioneers Dr. Matschoss, the author of this volume of biographies, has played a part second only to that of von Miller, whose efforts he furthered in every possible way. As editor of the publications of the Verein deutscher Ingenieure, then as director of the society, as the author of historical works and as a lecturer he has become known in both hemispheres as an authority on engineering history. This latest work from his pen, therefore, is no ordinary compilation, but a series of studies by one familiar with every aspect of the subject. It is a volume which should be read by every engineering student. The men recalled came from all sorts of homes, began life under various conditions, but they one and all by the exercise of their talents made notable contributions to knowledge. But, says Dr. Matschoss, "the great deeds of great men are not bound up with their lifetime. They take ever-growing effect in course of time, far beyond the earthly existence of the individual". It is, however, only history which can give us a measure by which a just estimate of great achievements can be made.

The book is arranged in three sections. First there is a brief review of the great engineers of antiquity. This is too short to be of much value and the subject probably did not appeal much to the author.

In the second part is a most admirable chapter on the German gunsmiths and others on Gutenberg, Leonardo de Vinci, Agricola and Otto von Guericke. It is probable no British writer would have included Gutenberg or Otto von Guericke in a volume on "great engineers". The choice, however, can be justified, for as Dr. Matschoss says, "perhaps no technical advance in any field has had so great an effect in promoting development in all other fields of human labour as the invention of printing". Looked at in this light, printing falls within Tredgold's famous definition. Otto von Guericke, it is true, was more of an experimentalist than an engineer, but he carried out his experiments in the manner of an engineer and paved the way for engineering developments. Historians of physical science may be interested to learn that Guericke's experiments with the hemispheres were not made before the Reichstag in Regensburg, in front of the Emperor and the German princes, but at Magdeburg and at a later date than that usually given.

The third and longest section of the book begins with Watt and the pioneers of the steam engine, and the last five studies are of Parsons, Edison, Westinghouse, Carl von Linde and Oskar von Miller. Among the other British engineers dealt with are Trevithick, the Stephensons, Maudslay, Nasmyth, Bessemer, and Sydney Gilchrist Thomas. America is represented by Fulton and by Ericsson, who though born in Sweden passed the greater part of his life in the United States. As might be expected, the studies of German pioneers are particularly good, and those on Holtzhausen, Dinnendahl and Reichenbach contain much information not known generally. But the careers of Alfred Krupp, Werner von Siemens, Otto, Langen, Daimler, Maybach and Diesel, and of Carl von Linde are all equally interesting. One could have wished that Dr. Matschoss had spread his net a little wider and had included one or two sketches of the engineers and inventors of a country which can boast of Seguin, Montgolfier, Fourneyron, Bourdon, Schneider, Giffard, Hirn, Clapeyron, Rateau and many others. We are altogether too unfamiliar with the history of engineering in France.

The book is well printed, the portraits are excellent and there is a good bibliography. There are one or two slips in the text. George Stephenson is stated to be buried near Chester, instead of

Chesterfield, and Robert Stephenson is said to be buried next to Watt in Westminster Abbey. Watt is buried at Handsworth, and Robert Stephenson was laid next to Telford, in the Abbey, at his own request. The statement about Ericsson's *Robert F. Stockton* should be altered to show that she did not cross the Atlantic by steam.

On the whole, many engineers will think that Dr. Matschoss has given us the best volume of engineering biographies so far published. He is naturally proud of the pioneering work of his countrymen, but he says "we are indebted to other nations as much as they are indebted to us".

BIRDS OF BRITAIN

The Handbook of British Birds

Vol. 3. (Hawks to Ducks.) By H. F. Witherby (Editor), Rev. F. C. R. Jourdain, Norman F. Ticehurst and Bernard W. Tucker. Pp. x + 388 + plates 61–92. (London: H. F. and G. Witherby, Ltd., 1939.) 25*s*. net.

THE third volume of this exhaustive work has just made its appearance, and is not inferior to its two successors in its high standard. The value of this volume is heightened by a number of admirable coloured sketches of geese by Peter Scott, his pictures of grey lags and of barnacle geese being particularly fine. Credit is also due to the producers of the book for having brought out so well the fine points of these sketches, always liable to be lost in reproduction. Mr. J. C. Harrison's delicate and masterly delineation of birds also finds a place in this volume. His plates (81 and 82) showing the adult males and females of British ducks in flight are delightful. No bird artist can excel Mr. Harrison in bringing to the mind the sense of movement in birds. His pintail and long-tailed ducks in flight are particularly attractive and he has caught the wise expression in the eye of the tufted duck—an expression which I often noticed in the tufted duck of Fallodon-full-winged birds which had been tamed so completely by Lord Grey that they were entirely without fear.

The birds which are written of in this volume are, among raptores, the falcons, golden eagle and sea eagle, buzzards, harriers, osprey and kite. It is gratifying to know that the kite, which is still confined to strictly protected areas in Wales, has increased from five birds in 1905 to fifteen birds in 1938. Of these fifteen kites, twelve were paired and three young were reared. Of the osprey we have no such cheering news. The two ancestral nesting haunts of this fine bird were on Loch an Eilein on Strathspey, where the last eggs were laid in 1899, and Loch Arkaig in Lochaber, where the eyrie on the oak tree on the island was last occupied in the year 1902. But there is some evidence that two eggs were laid and one young bird reared in a nest in the same district at a considerably later date than 1902, and even during the present year (1939) there are reports of ospreys being seen in the Highlands.

Geese and swans, herons and bitterns, find a place in this volume, and no fewer than 160 pages are devoted to the British ducks. Here is to be found an interesting map showing the nesting haunts of the eider around the British coasts. It is curious that this fine duck should be numerous at the southern fringe of its range; that it should nest plentifully on the Farne Islands—where it is known as St. Cuthbert's Duck and, it is said, owes its remarkable tameness to the work of St. Cuthbert—and on Coquet Island, and yet should be unknown as a nesting species south of that isle off the Northumbrian coast.

In the notes on the golden eagle—pp. 39 and 40—there are one or two mis-statements which may perhaps be corrected in a later edition. It is said that the golden eagle "formerly bred on sea-cliffs, but is now confined to moorland". This statement should be amended, for there are at the present day several golden eagles' eyries on sea-cliffs in Scotland. Then, again, we are told that the eyrie "in a few cases" is in trees, but in the Central Highlands a tree is a more usual nesting place than a cliff. The eyrie is a bulky structure, and during the summer of 1939 I saw an eyrie in an old pine, and estimated the depth of this eyrie as no less than fifteen feet: the nest must have been of very great age. To the statement that "in the west bracken is a much-favoured nesting material" I would say that in the many eagles' eyries I have examined I have never once found any trace of bracken. It is stated in the notes that fresh eggs are found usually about April 1–10, but in my experience the eggs are found during March 20–31, and any date later than this is unusual.

To the statement that both golden eagles provide food for the eaglets I would say that my wife and I have watched at hides at a number of eyries, and although our watching hours must have numbered many hundred, we *never* saw the female eagle

bring in food. The hunting was done entirely by the male, but the female fed the young, and cleaned up the eyrie by carrying away any old carcasses of prey.

It is stated that the young eagles remain with their parents until winter, but I would say rather that the month of October is the time they usually separate; they may then often be seen perched on some tree or on some rock, and permit of a comparatively near approach. S. G.

MATHEMATICS OF THE ARMAMENTS RACE

Generalized Foreign Politics

A Study in Group Psychology. By Dr. Lewis F. Richardson. (*British Journal of Psychology*, Monograph Supplements, 23.) Pp. viii+91. (Cambridge: At the University Press, 1939.) 8s. 6d. net.

THE application of mathematics to group phenomena such as those of the kinetic theory of gases and statistical mechanics has long been accepted by physicists. The extension of such methods to biology, economics, and psychology is also widely accepted. Dr. L. F. Richardson, who is well known for his work in physics and meteorology, but who also holds a degree in psychology, makes the daring attempt to deal mathematically with foreign politics, particularly with the growth of armaments and the motives which produce this growth. The author's method is to take a verbal argument of a leading statesman and replace it by differential equations. Thus, Sir Edward Grey said: "The increase of armaments that is intended in each nation to produce . . . a sense of security, does not produce these effects. On the contrary, it produces a consciousness of the strength of other nations and a sense of fear." This statement is replaced by a pair of differential equations, the meaning of which is certainly not exactly the same as that of the original statement. The differential equations really assert that for two nations, the rate of increase of expenditure on armaments by either is directly proportional to the total expenditure on armaments by the other. This variation of Grey's words is adopted because it is easy to deal with mathematically. However, it is immediately corrected by adding other terms, with a negative sign, to represent the restraining influence due to the burden of expense and fatigue, an influence not mentioned by Grey. The next step is to take account of an objection by Mr. Amery: "It was . . . in those insoluble conflicts of ambition and not in the armaments themselves that the cause of the War lay." An additional positive constant term is added to each equation to represent the extra rate of growth of the armament burden due to national grievances or ambitions.

Having set up the differential equations, it remains to solve them, and then to give the political interpretation of the solution. The exact solution offers no difficulty to mathematicians or mathematical physicists, as the equations are of a well-known type. Curiously enough, somewhat similar equations occur in a paper on "The Ignition of Explosive Gases". To meet the needs of those without much knowledge of mathematics, Dr. Richardson gives also a simple graphical treatment, which is similar to Marshall's diagram for the economics of international trade. In both the mathematical and the graphical treatment, the most important part of the work is to find out in what conditions the solutions become infinite. An infinite cost of armaments is interpreted as denoting war, though it might have seemed more natural to have taken it as bankruptcy. The final conclusions are difficult to state accurately in concise form, but they are roughly that there is a general tendency for peace to be unstable. This instability can be reduced by removing grievances, decreasing threats, and increasing international trade and other forms of co-operation. It is emphasized that increase of armaments, though undertaken as a measure of defence, tends to lead to war.

Opinions will differ as to the validity of this reasoning. Some may think that the author has made the first rough approximations in a new branch of science, which can be polished and corrected later. The mathematician, who knows that a small change in a differential equation can sometimes produce a large change in the solution, may be distrustful of the way in which the fundamental equations were obtained. Students of human affairs will assert, perhaps too hastily, that foreign politics cannot possibly be treated mathematically. However, the subtitle of the monograph is "A Study in Group Psychology", and possibly the method may be valid so far as the effects are entirely due to the group mind, to which a kind of statistical mechanics may be expected to apply. The author gives a numerical test of his theory for the years 1909–14, and it seems to accord closely with the facts for that period. One great defect is that the theory does not include the effect of "intelligent aggression planned by a leader as moves in a game of chess". Unfortunately, this is the aspect of the question which is of vital interest to millions to-day. H. T. H. PIAGGIO.

FILM REACTIONS AS A NEW APPROACH TO BIOLOGY*

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TOWARDS the end of the last century the biologist and physiologist were agreed that the biological entity was the whole living unit. This century has seen an attack on biological problems by the physical and organic chemist. The study of the living unit has been dropped, and in its place we find investigations on specialized processes such as oxidation and reduction or catalytic reactions. It is an unfortunate fact, as the late Sir William Hardy clearly pointed out, that in this method of approach the mechanism of the co-ordination or the integration of the activities of an assemblage of cells must remain insoluble. It is this very point which I think deserves some consideration. We must conclude that the mechanism of integration is at any rate dependent on a pre-existing organization of at least the major operative portions of the assemblage of cells. This raises a number of important problems such as: what types of organization are to be found in living material; how far control over chemical reactions can be effected by modification of the type or extent of such organization; and again how far different types of organization can modify such important factors as the chemical or physical state of a material or chemical equilibria in reacting systems; and lastly, what new properties or reactions make their appearance as a direct result of organization.

Whilst it has been frequently stated that one of the chief characteristics of living matter is that it contains a relatively large proportion of matter in what we designate the colloidal state, a closer analysis indicates that in fact the colloidal properties of living matter are due to the fact that an exceptionally large fraction both of material and of energy is present in films, membranes, fibres, fine capillaries and the like. It thus seems pertinent to inquire a little into the properties of surfaces of separation between bulk phases or of matter in the boundary state. These surfaces of separation can be considered as a new phase—the interphase—and for our discussion we must examine this phase and find in what respect it differs from the enclosing bulk phases.

While we must pay attention to the static properties such as composition, form and orientation, we must not forget that it is the dynamic properties of ingress and egress, of flow and chemical action in and with the two-dimensional contents of the phase, that we are particularly interested in, but any integrating features of the former are of great importance if it can be shown that they produce effects in the dynamics of the system which are not to be found in non-structural liquid or vaporous phases.

We already know that the composition of the interphase differs from that of either of the bulk phases in contact with it, and the general principles governing relationship between its composition and its three-dimensional partners were clearly enumerated by Willard Gibbs and Sir J. J. Thomson. Equally important are the considerations of Sir William Hardy and Irving Langmuir, who showed that in many cases when dealing with an interphase we were actually examining a monolayer—a hypothesis suggested by Lord Rayleigh. Finally, we know the molecules contained in the monolayer are orientated with respect to one another and to the plane of the interphase.

We have referred to the fact that molecules in a monolayer are orientated relative to one another and to the substrate and that this orientation can be altered by extension or compression. If the molecules in the monolayer undergo reaction with a reactant dissolved in the substrate, the rate of reaction may be modified by the charge in molecular orientation of the former. This is equivalent to a control of the steric factor and determining the path of approach of a reacting molecule or ion to the reactive portion of the other reactant. In this way both the reaction velocity and the height of the energy barrier or apparent energy of activation may be altered.

In the following table is given an example of such a variation in reaction effected by change in compression of a monolayer.

Attack on Lecithin Monolayers by 0·001 per cent Black Tiger Snake Venom at 20° and pH 7·2.

No. of lecithin molecules per sq. cm. × 10^{-14}	Half-life in minutes.
1·04	0·5
1·27	4
1·57	32
2·11	90

It is interesting to observe that these film reactions can be carried out with minute concentrations of strongly adsorbed reactants. Thus in the case of the attack of lecithin by snake venom to form lysolecithin, a half-life of about one hour is obtained with a concentration of venom as low

* From the presidential address to Section B (Chemistry) of the British Association, delivered at Dundee on August

as $2{\cdot}5\times 10^{-6}$ per cent. When cobra venom is examined by this method, it is found that only in extreme dilutions does any reaction occur. This inhibition at higher concentrations is due to proteins present in the cobra venom which are absorbed in preference to the enzyme by the lecithin monolayer. Egg albumin, although not so effective when added to black tiger venom, will produce a similar result. In addition to lecithinase present in snake venoms, other enzymes have been studied, and among them crystalline trypsin and crystalline pepsin, which rapidly digest monolayers of caseinogen, the former at *p*H 8 and the latter at *p*H 2. When the purified and crystalline enzyme preparations are employed, these enzyme actions on the protein monolayers behave exactly as in bulk phase, although the protein has undergone a process akin to denaturation. With unpurified proteolytic ferments, on the other hand, fatty acid protein complexes are invariably present which give rise to other phenomena.

In the reactions which we have discussed, the chemical processes involved do not differ from those which would occur in similar systems in the disorganized state and the only effects of molecular organization into orientated monolayers are noted in the alterations produced in accessibility of the groups as revealed by the rapidity of the reactions and in the apparent energies of activation.

A further consequence of molecular orientation at interphases is found in those cases where radiation incident on the surface produces photochemical action after absorption of quanta by chromophoric groups in the monolayer. If, as is the case in ring compounds, the extinction coefficients are different along the three molecular or group axes, the photochemical reaction rate can be varied by alteration of the orientation by compression. Thus the rate of photochemical hydrolytic fission followed by oxidation in protein monolayers at those points along the chain where the chromophoric groups are situate can be varied within wide limits by simple expansion or contraction.

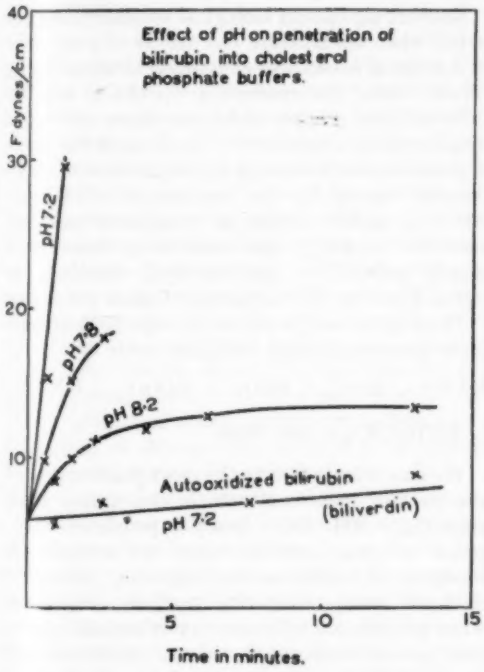
There are several processes in which an alteration in the properties of an interphase bring about a number of varied biological processes of great importance. I may mention the phenomena of lysis, agglutination, sensitization and the lethal activities of certain substances on various types of cells and micro-organisms.

Whilst the extent of mutual miscibility of two liquid phases is usually interpreted in terms of the relative internal pressures of the two liquids, we note from the molecular point of view, especially in the case of the large complex and the biologically important material, that we are really concerned with specific molecular interactions which may be identified as being due to those forces operative between the non-polar and the polar portions of the molecules respectively. In two-component monolayers the two molecular species are adlineated in respect to one another, and we should thus anticipate that it might be possible to form relatively stable two-component complexes which in three dimensions would only be detectable in terms of mutual solubility, and when a mutual solvent was present as a third component might not be observable at all. These conclusions are indeed fully borne out by investigations on two-component monolayers. It is found, for example, that strong complexes are formed in mixed monolayers of a variety of substances such as saponin with cholesterol or digitonin, or cetyl amine or sulphate with cholesterol.

Examination of a great variety of these systems has demonstrated that the free energy of formation of the complex is constitutive in the sense that its magnitude is dependent on the extent of interaction between the polar reactive groups and also that of the van der Waals interaction between the non-polar portions of the reacting species. The difference in properties of mixed films containing cholesterol on one hand and those containing, for example, epi-cholesterol is most marked, but when models are made of the two molecular systems, it becomes quite evident that the ease of adlineation of the hydrophobic portions of the molecule and the relative orientation of the polar group with respect to the axis of the molecule are the determining factors. The free energy changes involved in formation of these two-dimensional complexes are of the order of some 10,000 cal. per gm. mol. Complexes containing the constituents in ratios other than one to one can be prepared; thus cetyl alcohol and cetyl sulphate can form both a 1 : 1 and a somewhat unstable complex in the ratio of 1 : 3, whereas elaidyl alcohol produces an unstable 1 : 2 but no 1 : 3 complex. It is probable that with a more extended investigation of these interesting systems the basis for the most elementary form, that is, a two-dimensional crystallography of the type envisaged by Patterson, may be laid down.

I might mention in passing that the effects of cis-transisomerism on the free energies of the complexes are very characteristic and fully confirm the hypothesis we have advanced as to the importance of molecular adlineation; thus saturated aliphatic hydrocarbon chains with different reacting polar groups will form stable systems, likewise trans-olefinic chains can penetrate and pack both with one another and with saturated chains, but the cis- form is not capable of such adlineation. From the biological point of view, I think that the most interesting property of these systems lies in the mechanism of their formation, for on injection of one of the reactants beneath a monolayer

of the other, it is found that penetration of the latter by the former will take place to form the complex monolayer. This penetration, if carried out at constant area, naturally involves a rise in the two-dimensional pressure, or if at constant pressure a rise in area is involved. We have indeed examined the formation of complexes under both these conditions, and the changes involved are frequently remarkable. Thus the injection of a few mgm. of saponin under a film of cholesterol compressed to a pressure of 10 dynes/cm. will cause an increase of pressure of more than 50 dynes/cm.; whilst a film of cetyl alcohol at 20 A.^{2} per molecule



expands to no less than 78 A.^{2}, even when the pressure is maintained at 23 dynes/cm. on the injection of only 1 mgm. in 300 c.c. of cetyl sulphate.

In some cases a small alteration in the *p*H of the substrate may affect the ease of penetration of a reactant to a marked extent. In the accompanying diagram is shown the effect of such a variation on the rate and extent of penetration of bilirubin into cholesterol as a function of the *p*H.

It is possible to examine the reactivity of various substances in respect to penetration of monolayers. I have referred to the penetration of monolayers of cholesterol, and we note that some substances such as digitonin or cetyl sulphate or amine possess this property to a remarkable extent. Of the other important cell wall constituents we include phospholipins and the proteins. Little information as yet is available on phospholipins, but our knowledge of the reactions of this type in the case of the proteins, especially the alcohol-soluble and thus readily dispersible protein gliadin, has been greatly extended in recent years.

The stability of the protein monolayers is, as we have seen, due partly to their mutual association; if these are broken down by stronger associating reactants we might anticipate a dispersion of the monolayer resulting in a solution of the protein in the form of a protein-reactant complex. This phenomenon is readily observed on injection of even minute quantities of such substances as sodium oleate, cetyl sulphate, or psychosin beneath a protein monolayer.

Other substances may react by penetration into the protein layer but not effect dispersion. By spreading monolayers with various head groups and examining the reactions caused on injection, it is possible to identify the reacting group in the protein monolayer. A characteristic group of protein complexes formed in monolayers is the lipo proteins; thus gliadin forms a remarkable complex with cholesterol in the ratio 4 : 1 by weight. Here the cholesterol is anchored to specific groups in the gliadin, in particular the amino and carboxylic groups. At high pressures (20 dynes) the cholesterol is forced up above the protein monolayer and the surface becomes one essentially of cholesterol. Nevertheless the cholesterol is still anchored to specific portions of the protein, for on release of the pressure the lipo-protein film is re-formed. This extrusion and re-forming process can be repeated several times before the complex structure breaks down. It is interesting to note that saponin, which penetrates cholesterol with extreme ease, but proteins only slightly, will penetrate these lipo-protein films except at those pressures where the cholesterol is separated from the substrate by the protein monolayer to which the cholesterol is anchored.

It thus appears not unlikely that the materials such as cytoplasm, and especially in the more stratified chloroplasts, must be regarded as a protein gel framework to which is attached the enzymes, the phosphatides and lipoids and the means of attachment is as we have seen due to the interaction both of the non-polar as well as of the polar portions of the molecules concerned. Another important conclusion to be drawn from monolayer experiments is that these penetrative reactions involve not only a new head group interaction, but in many cases also the breaking of such a head group interaction already existing in the monolayer prior to penetration. Several biological analogies may be mentioned. Thus, since lysis of blood cells can be brought about both by protein and cholesterol penetrants, we must conclude that

it has lipo-protein surface. Several micro-organisms can be sensitized for lysis by cholesterol penetrants by a prior treatment with cholesterol. Again, cilia of Mytilus appear to be mainly lipoidal, those of Paramecia chiefly protein, as judged by the criterion of penetration.

The carrier action of desoxycholic acid on fatty acids can readily be demonstrated in monolayers, as desoxycholic acid does not interact with other lipoids, nor to any great extent with proteins. We find also that the hæmolytic activity of a long-chain alcohol is negligibly small owing to the fact that it is practically insoluble in water; but it readily forms a soluble complex with a long-chain sulphate and can be transported to the cell wall in this form. There both the sulphate and the alcohol can penetrate separately, the former acting both on the protein and on the lipoid, the latter only on the protein, and produce lysis.

Yet another reaction of this type has been described by Peters and Wakelin, who found that the complex ovoverdin containing protein and astacin could be split to form a lipo-protein containing soap by the addition of small amounts of saturated long-chain fatty acids setting free the astacin. On the addition of calcium ions the process is reversed. They likewise direct attention to the fact that it seems probable that the co-enzyme in an oxidase system may be separated from the enzyme by the formation of such a lipo-protein complex.

Somewhat more complex in behaviour are the blood coagulants, heparin and the synthetic sulphate celluloses. It is found that their biological activities run parallel to the ease with which they penetrate films of cholesterol. It is not unlikely that they operate by breaking down a cholesterol cephalin complex, setting the latter free.

We have referred to the fact that, for the penetration of a monolayer by a substance injected into the substrate, primary interaction between the reactive head groups occurs, followed by solution, that is, penetration and adlineation, of the tail. In the case of reactants containing two or more reactive head groups, it is found that these can associate with head groups in the monolayer and thus form a series of links. Here another important factor is found operative. If the injected bipolar molecule possess a hydrophobic portion of such a structure that it can pack or adlineate with its neighbours beneath the monolayer, the resultant composite film is remarkably stable. Thus the long-chain dibasic acids are adsorbed on to, but do not penetrate, monolayers of amines, whilst the diamidines are adsorbed by, but do not penetrate, monolayers of cholesterol. Substances containing the phenolic group are of particular interest in this respect, as they include a number of biologically important substances. They react with amine groups quite readily, and to a less extent, with the imido group in a polypeptide chain. Gallic and tannic acids react with great ease with monolayers both of amines and with proteins. It is interesting to note that the reactivity of tannic acid with the spaced amine groups of the protein is high, and that subsequent injection of fatty acids beneath such treated monolayers results in the dispersion of the galloylamine or galloyl-protein complex film, but not in the tanned one—an indication of the effectiveness of the interlinkage produced in the non-dispersible network by the multiple point contact of the large tannic acid molecules.

Another significant biological similarity has been noted when we measure the extent of penetration of a series of substances containing identical hydrophobic 'tails,' for example a C_{12} chain, but with different head groups, into a monolayer of a typical lipoid such as cholesterol. In all cases the extent of interaction as measured by the increase in surface pressure caused by the injection of 0·33 mgm./100 c.c. under a film of cholesterol originally extended to 40 A.^{2} per molecule is found to be closely parallel to the hæmolytic activities and lethal activities on Paramecia of these substances.

These latter can be placed in order both of monolayer penetration and biological activ ty :

$$RNH_3^+ > RSO_4' > RSO_3' > RCOO' > RN(\overset{+}{C}H_3)_3 > RNH(\overset{+}{C}H_3)_3 > \text{bile acids.}$$

We may conclude that the most reactive group in the protein macromolecule is the amino group, since the —NH—CO— group is poorly reactive, a point of some interest when we examine the reactions of lecithin and of cephalin. This order of head group reactivity receives confirmation when penetration into monolayers containing these head groups is examined, that is, on inverting the system. When we compare the reactivities of a series of long-chain compounds with identical head groups, it is found that biological activity and film penetration commences with C_8 when attached to a very reactive head group, with C_{12} when attached to a poorly reactive group, and reaches a maximum value at *c.* C_{18}. It is interesting to note that it is not necessary for all the carbon atoms to be in the form of a chain but that they may be enclosed in rings; thus activity commences with diphenyl derivatives and increases with addition of carbon atoms to an optimum, as in the bile acids, stearic acid, diethyl stilbene and benzpyrene. By examining the reactivity of substances containing two reactive groups at various spacings underneath protein monolayers, it is possible to obtain some idea as to the statistical distribution of the reactive groups in the monolayer. It would appear that

some 12·5 A. is the mean distribution of the amine groups beneath a gliadin film. In the native protein such spacings are naturally different, and thus reactions involving two-point contact will not take place in bulk phase unless the spacing is unaffected by two-dimensional unrolling of the protein.

We have referred to the modification which must be introduced into either the Overton Meyer or Traube concepts of biological activity, that is, lipoid solubility or capillary activity necessitated by the concept of specific head group interaction. We see that a definite limit is also set to the hydrophobic portion of the molecule, not only on account of the decreasing solubility in the aqueous phase causing difficulty in transport, and on account of the ease of adlineation or packing having an optimum of C_{18} for association with sterols or fats, but also because a new phenomenon sets in with long chains, namely, dispersion of the monolayer. It is possible that this phenomenon of film collapse and dispersion may be a generally important factor in setting the upper limit to the chain length, or more generally the capillary activity of homogeneous series of biologically important substances, for example, anæsthetics. This dispersion of protein films may have biological counterparts in adsorption on specific portions of the cell surface similar to the hæmolytic activity of long-chain compounds such as oleic acid, which readily disperses protein films.

This method of attack permits us to investigate the nature of the coatings of cells or unicellular animals and plants by examining the effects of lipoid or protein penetrating substances on them.

Thus both red cells and Paramecia are affected by both lipoid and protein monolayer penetrating (cytolysing) or adsorbing (agglutinating) agents, and we deduce that their surface structures must contain lipoproteins or consist of a lipoid protein mosaic; whereas certain other unicellular animals frequently found associated with Paramecia and in addition the cilia of Mytilus are not affected by protein dispersants but are readily influenced by lipoid penetrating agents, and their coatings in consequence must be chiefly lipoidal in nature.

Examination of the carcinogenic hydrocarbons by the monolayer technique reveals the interesting fact that, whilst they themselves are unreactive, they are readily converted into extremely reactive water-soluble photo-oxides. These substances are not only reactive to protein monolayers like the water-soluble dibenzanthracene endosuccinate, but also are paramecicidal, the parallelism between the biological activity and monolayer reaction being maintained.

It has been the purpose of this address to re-emphasize the importance of the fundamental concepts introduced by Sir William Hardy and Dr. I. Langmuir as to the structure of matter in the boundary state. I have attempted to show that there is implicitly contained in the concept of molecular orientation a whole series of properties and events for which there are no analogies in homogeneous bulk phase systems. We note that many of the modes and types of the reactions which can be effected in monolayers, and which can be defined with precision and their mechanism established with a considerable degree of assurance, are unique for such interphases, but are again observed in living and organized material. It is with this object of ultimate correlation with biological behaviour that we have taken up the detailed study of interfacial reactions at Cambridge, and I should like to express my indebtedness to Dr. J. Schulman, who has been associated with me in this object.

Many 'vitalistic' models have been proposed in the past, and whilst it might be correct, although unscientific, to suggest that the ultimate level of integration in living matter is incapable of examination and definition, yet I believe that one is justified in asserting that at least one of the important levels to which due attention must be given for a proper understanding of biological activities is that of the ordered interface.

CULTURAL SIGNIFICANCE OF ANTHROPOLOGICAL STUDIES*

By Prof. H. J. Fleure, F.R.S.,

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THE vision of a universe in evolution has shown men that what had been accepted as absolutes are in several cases by-products of evolution. Old beliefs are increasingly relegated to the domain of folklore survivals, and the effects of this upon motive power in personal and social conduct are major factors of the present crisis in world affairs. Having been so long accustomed to accept an absolute basis which has now been undermined, men have hastily sought a new

* Prepared for a discussion on "Anthropology in Education" arranged by Section H (Anthropology) for the Dundee Meeting of the British Association.

absolute, and some think they have found it in the State, which is being made an object of worship. This growth of State worship has come earlier on the Continent than in Britain, for we have pursued our traditional policy of finding a compromise that postpones the crises due to insoluble problems. Evangelical and tractarian movements have had influences of this kind on British life; they have counted for much less on the Continent. Again, State worship has grown with the acceleration of production and communications, a process that has given rise to an uncomfortable feeling of jostling and trade-pressure. We have attained to an anarchy of sovereign States and understand one another too little.

To study the peoples of the world in process of evolution in their varied environments is thus one of the greatest needs of our time. Men and women, their physical characteristics and functions, their social organization and material equipment, their reproductive rates and all that is linked with this, interrelations of groups, including production and exchange of commodities and ideas, their systems of control and the clashes thence arising, all need deeper interpretation for all peoples of the world, from the pigmies of the equatorial forest to the citizens of the United States of North America.

Specialists have taken up studies in physical anthropology, in social organization especially of the illiterate peoples, in archæology, in human geography and so on. But the difficulty has arisen that these subjects are too separate to allow a sufficient number of those who follow some of them to find opportunities to teach them in such a way as to make them a feature of a general education. So long as they remain pure specialisms, they must have small followings. We need a co-operative scheme that will bring them together, not as one 'subject', but rather as a linked group.

The human geographer, seeking to elucidate relations between men and environment, will study situation, climate in its relation with vegetation, and the annual cycle of cultivation, and this should lead on to the discussion of the round of festivals and ceremonies that marks the agricultural year. Here the social anthropologist dovetails with his appreciation of those rites and ceremonies his understanding of the fact that both these and the agricultural processes they accompany are not results of direct planning but rather the product of ages of 'trial and error'. This undeliberate method has been man's chief tool through the ages; the reason has come in to correct misapprehensions and wrong sequences of argument. The human geographer, again, will try to understand land-tenure and will appreciate the fact that better watered patches in an arid area are likely to have a scheme of tenure different from that used in areas of equatorial forest.

The anthropologist will then come in and study schemes of inheritance and control of land, and so one might go on and show how human geography and anthropology combine. The more they are studied together the better will it be for both subjects, for both their research and their educational aspects. They may co-operate with special advantage in studying the changes of land tenure, agriculture, organization and government among African peoples who have come into contact with Europeans. Intertropical Africa produced very little for export sixty years ago; recently its export trade approached one hundred million pounds sterling per annum. This change has had many repercussions on every part of a social structure that had been built up on subsistence agriculture and the almost completely self-supplying village. An analogous change from local self-sufficiency to complex interdependence has been going on among the peasantry of Europe in the last hundred years, and this is part of the problem of clashing national sovereignties that is threatening ruin to us all.

During the last twenty years, archæologists have realized, to a greater extent perhaps than social anthropologists, the need for studying environment. Concurrent studies of climate change, recently assisted by work on pollen analysis, and of soils, have shown increasingly that environments have undergone extensive changes within the period of human history and that reconstructions of environments of the past should be reconstructions for the climatic and vegetative conditions of a specified period. It has also been increasingly realized that prehistoric archæology tells us about our own ancestors, not about exterminated and forgotten peoples, and this has been an important factor in making archæology a study of the evolution of the future from the past.

At the same time, there is increased objection to accepting old parallels between peoples of antiquity and peoples of to-day. It is now considered less than a half-truth to say that the Australian blackfellows are surviving Mousterians, or the Bushmen of South West Africa surviving Aurignacians. Some of the Aurignacians were the leading peoples of their day and were on the upgrade; the Bushmen are rather a lingering remnant. Bushmen and Australians have picked up fragments of more advanced cultures even if, in some cases, these fragments are barely half-digested.

Physical anthropology, greatly helped by modern views of heredity, is learning to treat mass statistics with reserve and to criticize schemes of classification. Head form and pigmentation, for example,

have very different kinds of histories. Depigmentation has affected a number of elements of differing bony structure in north-west Europe, and the idea of a unified Nordic race belonging basically to the Baltic is almost as fantastic as the twin-fancy that this Nordic race developed the essentials of European civilization and spread them from this assumed early home.

My plea is that a group of linked humane studies based on direct observation and measurement is needed not only for specialist work but also at all stages of education, and that the group should include human geography, social anthropology, physical anthropology and archæology, though it is obvious that one can scarcely expect any one person to cover all these specialisms. All that is needed is that they should have some common ground.

OBITUARIES

Prof. R. S. Troup, C.M.G., C.I.E., F.R.S.

THE death of Prof. R. S. Troup on October 1, at the age of sixty-four years, removes one of the outstanding figures in the development of forestry in the Empire. He passed the competitive examination into the Royal Indian Engineering College at Coopers Hill in 1894, and ever since then his profession had been his predominant interest. Endowed with more than the usual amount of Scottish common sense and with a good deal of Aberdonian caution, his mentality was peculiarly adapted to the orderly collection and presentation of facts.

After a brilliant career at Coopers Hill, where he took a number of prizes, not only among the few forest students, but also in competition with the far more numerous students of the engineering side, in such subjects as geology and surveying, Troup went to Burma with the other four men of his year. There he started with practical experience in some of the finest and best managed forests of the Empire. His reputation had preceded him and after a few years he was called to Dehra Dun, then beginning to assume its position as the headquarters of the Indian Forest Service. From about 1904 until 1920, when he left India, he was engaged in research and administrative and scholastic work, as a teacher at the Forest College, as forest economist, as sylviculturist, and finally as assistant inspector general of forests to the Government of India. These posts gave him unique opportunities not only of seeing all the finest forests in the quarter of a million square mile forest estate of the Indian Empire, but also of gaining an accurate knowledge of how this magnificent property could and should benefit the population.

Troup's own interests lay more in scientific sylviculture than in the utilization side, but his early training ensured that he should fully recognize that first-class sylviculture is not an end in itself but, to put it briefly, a means of obtaining the largest volume of the finest timber on a given area. Apart from a number of publications on the uses of woods and allied subjects, the principal works which he produced during his service in India were "The Silviculture of Indian Trees" in three fine volumes and "A Note on some European Sylvicultural Systems with Suggestions for Improvements in Indian Forest Management". This latter work, "the outcome of a tour made in 1913 in certain selected forests of France and Germany", appeared in 1916, and has always seemed to the writer to be of outstanding interest. Illustrated by excellent and well-chosen photographs, a clear and vivid description is given of all the important sylvicultural systems employed on the continent of Europe, and the possibility of their adaptation to the very different conditions of India and Burma is fully discussed. "Silvicultural Systems", which was published by the Clarendon Press in 1928, is an up-to-date and more generalized study of the same kind. It has been praised by Continental experts as being better than anything they have. In the work of 1916, Troup gave evidence of a very broad and catholic outlook on the main problems of Indian forestry, and established the principles on which the most important measures of progress have been based during the last twenty-five years.

Troup's greatest work, "The Silviculture of Indian Trees", appeared in 1921 and is, in his own words, "the outcome of several years of research into silvicultural problems at the Forest Research Institute, Dehra Dun, and at outlying experimental stations, combined with observations recorded in many parts of India and Burma for a period extending over twenty years". The writer, having accompanied Troup on many occasions in the field, can confirm the care with which these observations were made and recorded, and can testify to the technical interest of the scholarly descriptions of the very varied types of forests in India and Burma and to the great value of the estimates of the sylvicultural needs of the more important species. Constant use has been made by Indian forest officers of the information stored in these volumes, which have become standard works of reference, and contain much that was not available before.

After leaving India to succeed Sir William Schlich as professor of forestry at Oxford, Troup's interests gradually changed, and, as the result of a number of tours to various parts of the Empire, particularly Africa, he became recognized as an authority on forestry in the Colonies, and was, at the time of his death, engaged on a work on Colonial forest administration. His last publication, in 1938, was a small volume on "Forestry and State Control", which reviews the position in all the more important forest

countries of Europe, with particular reference to the urgent need for improving the private forests of Great Britain.

His devotion to his profession and his remarkable ability in summarizing clearly and fully the salient points of any forestry problem earned for Troup a unique position, and made him a worthy successor to the great men of the earlier years of Indian forestry. He was also a good 'jungle man' with a proper appreciation of life in wild places, with a keen interest in the forest flora and fauna, and, in his younger days, a great love of sport. He was a successful 'shikari' and a very good shot. ALEXANDER RODGER.

Prof. Ricardo Jorge

PROF. RICARDO JORGE, an eminent Portuguese hygienist and medical historian, was born on May 22, 1858, at Oporto, where he received his medical education and carried out some important work on plague in conjunction with Dr. Camara Pestana. He afterwards went to Lisbon, where he was appointed director-general of public health and professor of hygiene.

In 1912 Prof. Jorge was made the delegate for Portugal in the International Office of Public Health in Paris, where he was a regular attendant at its meetings and contributed important papers to its proceedings until shortly before his death. His published work comprised a large number of subjects, such as undulant fever, tuberculosis, pellagra, lethargic encephalitis and its mental sequels, alastrim, post-vaccinial encephalitis, epidemics on ships, especially the typhoid form of malaria and dengue, spirochætal jaundice, influenza and epidemic pleurodynia. As medical historian, he took an active part in the proceedings of the International Society of the History of Medicine, to which he contributed scholarly articles on the epidemics of the sixteenth century, the Renaissance in anatomy and medicine in Portugal, medical and scientific relations between England and Portugal and plague epidemics in Europe.

In addition to his medical activities, Prof. Jorge took a keen interest in literature, art, history, philosophy and philology, so that he has often been compared to the humanists of the Renaissance. He counted many friends in Great Britain, where he was elected an honorary fellow of the Royal Society of Medicine in 1938, twelve years after he had been made an honorary member of the Section of Epidemiology. One of his last writings was a sympathetic obituary notice of Sir George Buchanan, his colleague at the International Office of Public Health. His death took place on July 31 at the age of eighty-one years. J. D. ROLLESTON.

WE regret to announce the following deaths:

Sir William Pope, K.B.E., F.R.S., professor of chemistry in the University of Cambridge, on October 17, aged sixty-nine years.

Dr. W. B. Wright, late of the Geological Survey of Great Britain, author of "The Quaternary Ice Age", on October 11, aged sixty-three years.

NEWS AND VIEWS

Ministry of Information

THE debate in the House of Commons last week on the Ministry of Information was announced too late for account to be taken of it in the leading article on the suggested Directorate of Scientific Information in NATURE of October 14, but there appears to have been nothing said which invalidates the comments in that article; indeed, the debate rather served to emphasize the importance of the principal points. Replying on behalf of the Government, Sir Samuel Hoare admitted that the public had lost confidence in the Ministry, and outlined the steps taken for its reorganization. Two factors have no doubt contributed largely to the difficulties of the Ministry, namely, confusion between the task of collecting information and of disseminating it, and the failure to utilize effectively organizations already in existence. The first has involved the Ministry in the difficult question of censorship and authority in relation to other Departments of State; the second has been responsible for excesses of expenditure and lapses of judgment for which the Ministry has been rightly criticized. It is not always realized that the collection of information in itself is a specialized activity. In the technical and scientific sense it is the task of the numerous information bureaux or departments, such as various Imperial Agricultural Bureaux, those associated with different research and other associations or with individual industrial firms. Activities of this kind are to be found over the whole range of industry and science, including the social sciences. To some extent the Association of Special Libraries and Information Bureaux serves as a clearing house in this field, and its services have already been offered to the Government. Official recognition of the vital necessity of information services and their co-ordination does not as yet appear to have been forthcoming, nor has their utilization by Government Departments and other organizations concerned with national service been encouraged, a situation which would scarcely have arisen had the Ministry been provided with adequate scientific guidance.

The collection of more general information in the sense of news is the essential task of the journalist, and some of the severest criticism of the Ministry of Information has been based on its neglect of the unrivalled experience and organization of the daily Press, both in the collection of news and in the problems involved in handling it. The statement

that news and censorship will now, generally speaking, be separated from the Ministry of Information, may make such criticism irrelevant so far as the Ministry is concerned, but the Government would do well to take the lesson to heart, for other departments also have tended to make the mistake of formulating complete plans of their own instead of making the utmost use from the start of existing organizations and facilities. The collection of information is one activity demanding a particular technique and type of mind; the dissemination of information is another activity and may require entirely different gifts. Incidentally, most information departments are concerned with both these activities in that they collect information for use. The first essentials in handling information are sound judgment and a clear understanding of the extent to which the use of a particular piece of information is to be limited, either in the general interests of the industry or organization which an information department is serving or, as with the Ministry of Information, of the national interests in the widest sense. The work of the ablest information bureaux, however, can be seriously injured by departmentalism which is lacking in vision or a sense of proportion. Sir Edward Grigg, Parliamentary Secretary to the Ministry, was able to give a welcome assurance that no effort would be spared by the Ministry to see that the country preserved its right to know the truth about the war in which we are engaged and its right to comment with absolute freedom on that truth.

Peace Aims

THE correspondence columns of the leading lay journals have given ample evidence of the lively concern felt by thoughtful men everywhere as to the ultimate goal towards which Great Britain and France are striving through the present conflict. A noteworthy pronouncement in the form of a manifesto signed by no fewer than fifty-seven men of science, all of whom are fellows of the Royal Society, appears in the *Manchester Guardian* of October 13. The names of the signatories represent many branches of scientific investigation, but in the covering letter sent with the manifesto and signed by the Bishop of Birmingham, Sir Richard Gregory, Prof. Lancelot Hogben, Sir John Orr, Prof. A. J. Clark and Sir Peter Chalmers Mitchell, it is pointed out that they "do not claim to speak for their scientific colleagues as a body". The manifesto points out that the "progress of science and its application to human well-being are threatened by the prevailing anarchy of international relations", and states that a new international order, going far beyond the provisions of the Covenant of the League of Nations in its claims on individual States, should be set up when the war ends. All nations prepared to renounce war between themselves should be invited to unite under a federal Government, which would have power to use armed force against aggression, would control the raw materials of undeveloped territories in the possession of member States, and would undertake the education of backward communities without racial discrimination. Although experience of the League of Nations shows that these provisions are bristling with practical difficulties, there will be general agreement that a new world order based upon them would command the support of a considerable body of informed opinion.

T. K. Penniman

THE curatorship of the Pitt-Rivers Museum in the University of Oxford, which has been vacant since the death of Dr. Henry Balfour earlier in the year, has been filled by the appointment of Thomas Kenneth Penniman, the appointment being for a period of seven years dating from October 1, 1939. Mr. Penniman is a member of Trinity College, Oxford, and holds the diploma in anthropology of the University of Oxford. He is the secretary of the Board of Anthropological Studies in the University, and is the author of a history of the progress in anthropological studies in the last hundred years, which in its introductory chapters traces the beginnings of anthropological observation, the work thus being a complete survey of the development of the science. Mr. Penniman was also joint editor with Dr. R. R. Marett of the correspondence of the late Sir Baldwin Spencer, the distinguished authority on the primitive tribes of central and northern Australia.

Robert Henry Thurston (1839-1903)

ON October 25, Cornell University will celebrate the centenary of the birth of Robert Henry Thurston, the distinguished American professor of engineering, who by his work at the Stevens Institute of Technology, Hoboken, and the Sibley College of Engineering, Cornell University, contributed more than any other man of his time to the advancement of engineering education in the United States. Thurston was a man of great force of character, but sympathetic, the friend of all his students, and he was possessed of a wide and generous outlook. With a remarkable memory, great powers of concentration and unceasing industry, he was not only a teacher and engineer, but also an original investigator, an expert, and a public servant. He published some 300 scientific and technical papers and twenty separate works. When engineering education was in its infancy he founded the first engineering laboratory in the United States, and he was the first to serve as president of the American Society of Mechanical Engineers.

THURSTON was born at Providence, R.I., the son of Robert L. Thurston, one of the pioneers of steam engineering in America. At the age of sixteen he entered Brown University, and after graduating, went into his father's workshops. The Civil War saw him an assistant engineer in the U.S. Navy, and at its close, in 1865, he was made an assistant professor of natural philosophy at the Naval Academy, Annapolis. This, however, was but a stepping stone. On the inauguration in 1870 of the Stevens Institute of Technology, Hoboken, the president, Henry Morton, invited him to become professor of mechanical engineering. For fifteen years he laboured at Hoboken and then, in 1885, the trustees of the Cornell University asked him to undertake the organization and development

of the Sibley College of Engineering. When he took charge the total attendances in all classes was about 60; at his death in 1903 the attendances were about 960. The teaching staff had grown from 7 to 43. Besides his work as a teacher, writer and experimentalist, Thurston served on various committees and was a member of numerous societies both at home and abroad. The gathering at Ithaca on October 25 will pay tribute to his memory, and will also discuss ways in which engineering may meet the crucial challenge of our rapidly changing world.

A National Atlas of Great Britain

THE report of the committee appointed by the British Association in 1938 to prepare a scheme for a projected National Atlas of Great Britain and Northern Ireland was presented to the Association at the Dundee meeting and contains provisional details of the format and contents of such an atlas. "The proposed atlas," the report runs, "aims at a strictly objective and scientific presentation of the natural conditions, natural resources and economic development of the land (and adjacent seas), of the history and pre-history of the country, and of the distributions, occupations, movement and social conditions of the population." To this very comprehensive programme the proviso must be added "in so far as they provide suitable material for cartographic exposition", since it is not intended that there shall be any accompanying text to the maps. Such a work necessarily involves the collaboration of scientific workers in very different fields, and six sections of the Association were represented on the reporting committee, which sat under the chairmanship of Prof. E. G. R. Taylor (Section E).

THE complete Atlas will be in two large folio volumes, each volume containing 60–70 plates. The number of maps will, of course, be many times greater than the number of plates, but the sheet size has been selected so as to show the whole of England and Wales at a single opening on the scale of one to a million, a scale which experience has shown to be appropriate for many types of general map. The maps are grouped under four general headings: physical geography, bio-geography, industry and commerce, and human geography. Under physical geography are included cartography, orography, geology (with geomorphology), climatology and hydrography. Under bio-geography the sub-headings are soil, vegetation, distribution of species, pre-history (of plants), land utilization, forestry and agriculture. Many of the maps will be of types not hitherto constructed, or at least not hitherto published for Great Britain. Such, for example, are maps dealing with health and disease, recreation and amenities, which fall within the human geography section, and maps of accessibility from and to the leading cities, in the section devoted to industry and commerce. For certain sections and sub-sections, the contents of individual maps are indicated in the report, the object being to ensure constructive criticism and co-operation from workers engaged in particular fields of research. As the report states, the success of the enterprise "must depend on scientific workers and scientific bodies willing to undertake responsibility for the accuracy of maps within particular fields".

Contemporaries of the Mammoth

IN an article contributed to "Russia To-day Press Service" (Sept. 12, 1939) Prof. P. Kapterev gives an account of his experiments with organisms contained in frozen soil from Siberia. A paper by Prof. Kapterev on his discoveries was read before the Academy of Sciences of the U.S.S.R. during 1936 (see NATURE, 138, 714; 1936). The flora associated with the mammoth has been known for years from the contents of the food canal of frozen individuals, but it is astounding to learn that plants and animals contemporary with the mammoth have been brought to life after remaining in a state of suspended animation which at a low computation must have extended over twenty thousand years. The soil from which the organisms were obtained consisted of silt strata obtained in the galleries of mines in the taiga of Siberia at a depth of 131½ feet, far within the limit of the permanently frozen soil, for even in the hottest summer the thaw never penetrates deeper than seven to ten feet. In contemporary strata the explorers found the bones of mammoths, the woolly rhinoceros, bison, and musk-ox, indicating a period contemporary with the interglacial period which came between the last two Ice Ages (Riss-Würm period) or with the last Ice Age (Würm period). The soil samples were placed in sterilized containers in a sterilized atmosphere, and they eventually yielded living organisms which included several kinds of soil bacteria, including a distinctive nitrogen bacterium, fungi and water plants, the majority being closely related to present-day forms. From another sample of later geological date, taken at a depth of 14 feet, twenty different kinds of water-plants, mosses, filaments of fungi and a crustacean (entomostracan) were obtained, and placed in favourable laboratory conditions these organisms began to multiply rapidly. But this stratum is reckoned to have been only from one to three thousand years old!

Archæological Excavations in Northern Syria

MR. M. E. L. MALLOWAN'S account of his further excavations in Northern Syria in the report of the British School of Archæology in Iraq (Gertrude Bell Memorial) for the year ended June 30, 1939, again records a striking frequency in the occurrence of amulets of various kinds among the finds—a feature to which attention was directed in earlier reports. The report on Mr. Mallowan's work covers the fifth expedition to Northern Syria and the third consecutive season's excavations at Brak, one of the largest of the mounds in this part of Syria. The great mud-brick temple, which Mr. Mallowan has named "The Temple of a Thousand Eyes" on account of the enormous number of alabaster "eye idols" found in the foundations of the platform on which the temple is built, has so far produced the most

important discoveries of the expedition. Its dimensions are approximately 30 yards by 25 yards; and its walls are exceptionally heavy, the outer walls being more than eight feet thick. They are buttressed with rough blocks of limestone and basalt. The temple dates from about 3000 B.C. and is thus the oldest shrine yet discovered in eastern Syria. Its architectural relationship to archaic temples at Warka, about eight hundred miles down the Euphrates from Brak, points to cultural contacts between north-east Syria and Sumer at this early date. A striking feature of the plan of the temple is a central shrine, three times as long as it is wide, with a pedestal for the presiding god against the end wall.

The adornment of the temple would appear to have been remarkable. A magnificent frieze consisted of three separate panels on the three faces of the pedestal in the sanctuary. Each of these was three feet in length and eight inches in breadth, and was composed of outer bands of heavy gold foil encasing blue limestone, white marble, and green corrugated shale. The panels were fastened to a wooden background with copper holdfasts, while the gold borders were held down by gold-headed nails with silver stems. No panels of this kind have previously been discovered. One of them has been allocated to the British Museum. Fragments of fluted copper panelling, which had adorned the walls, have been discovered; while on the south side the wall was embellished with a mosaic of clay cones painted in bright colours, and surmounted by large stone rosettes with alternate petals of white marble and dark green shale and a central corolla of red limestone. In the material of the mud-brick platform on which the temple stood, many thousands of objects were found. These include many beautifully carved amulets—models of lions, rams, bears, monkeys and vultures in serpentine and bone. A number of human heads in alabaster are said to be landmarks in the history of sculpture. A summary of the report appeared in *The Times* of October 14.

Juvenile Delinquency

In a discussion on juvenile delinquency before the Royal Statistical Society on April 18 which has now appeared (*J. Roy. Statist. Soc.*, 102, 384; 1939), Dr. Rhodes concludes that juvenile crime appears to be part of a major problem, including adult crime, which involves social and economic considerations. More exact information regarding the age-constitution of local populations is required to gauge properly the differences between the incidence of juvenile crime in different parts of the country. In considering changes with time, we must take account of changing environment if we are to deduce anything from the facts of recorded crime regarding changes in the naughtiness of the juvenile population. Mr. C. P. Hill agreed that juvenile delinquency was linked both with density of population and with unemployment, but considered there were so many other unknown variables to be taken into account that no accurate forecast was possible as to the probable future course of juvenile delinquency from the data available. Mr. J. H. Bagot, from Liverpool experience, stressed the wastage in probation and education offices and police departments through the non-use of statistics, and concluded that the vast proportion of the delinquents were drawn from one section of the population, and, within that section, from a defective group, either from the point of view of family or overcrowding.

Alcohol and Crime

In an important paper on the problem of alcohol and drug addiction in relation to crime, published in the October issue of the *British Journal of Inebriety*, Dr. W. Norwood East, formerly H.M. Commissioner of Prisons, discusses the relation of parental alcoholism and drug addiction to crime, alcoholism in the individual as a cause of crime, the medical and legal aspects of alcoholic crime, and the treatment of criminal alcoholics and drug addicts. He illustrates the insignificant part played by drug addiction as a cause of crime, at least in Great Britain, by the fact that in 1937, when the number of drug addicts known to the central authority was only 620, not more than 31 persons were dealt with under the Probation of Offenders Act, or fined or imprisoned for offences against the Dangerous Drugs Act. Dr. East further points out that while every practical criminologist will attach some importance to the association of alcoholism and crime, it is easy to over-emphasize the connexion, and in support of this contention brings forward statistics from various prisons showing that familial or individual alcoholism is a much less frequent cause of crime than was formerly supposed. While allowing that the general medical treatment of alcoholism and drug addiction may be supplemented by psychotherapy in suitable cases, Dr. East asserts that this method is apt to be disappointing, and that he does not know of any impressive series of figures illustrating the success of such treatment.

Future of Welding

It is now known that the substitution of fabrication for casting is very advantageous to heavy-machine makers in a number of ways, mainly because it obviates the necessity of pattern-making. The time that would otherwise be lost in the foundry is considerable, especially when new patterns have to be evolved. In a leader on welding in the *Electrical Review* of September 29, it is stated that many electrical and allied manufacturers are now using welding on a fairly large scale. Some of them go so far as to design and make their own welding equipment. There are on a conservative estimate about forty manufacturers of electric welding machines in Great Britain and there are nearly as many suppliers of rectifiers for welding and thermionic valve control devices. Besides, there are one or two factories which make holding frames for rotating or otherwise manipulating the welding work being done. It is probable that not more than about a quarter of the known applications of welding are utilized in industry. The large amount of research being done is shown

in the second progress report of the Institute of Welding. Further evidence is given of the increased applications by the issue of official regulations and specifications for welded steelwork by national bodies in many countries. Some manufacturers think that the welding industry may ultimately employ as much capital and labour as the steel industry now does. Such considerations apply equally to shipyards, and remembering the inherent water, oil and gas tightness of welded vessels, the rate of advance in the use of welding in shipyards will doubtless advance more rapidly in the future. The progressive widening of applications is producing fresh problems. Large-scale operations indicate the desirability of carrying out as much as possible of the actual welding in specially devised workshops rather than at the ship-building berth. This requirement will sometimes entail the re-design of component sections to render them more transportable and also the provision of suitable and adequate manipulative and adequate lifting equipment.

Johannesburg Municipal Bus and Tram Sheds

THE all-welded structure of the new municipal bus and tram sheds at Johannesburg is claimed to cover an area greater than that of any other welded structure in South Africa. In *Electric Welding* of August, it is stated that, excluding an office block of reinforced concrete, the building has a frontage of 465 feet and an area of approximately 186,000 square feet. The outer walls are of concrete but all the interior walls are steel-framed. The floor is of concrete throughout. To give unobstructed floor space, the number of columns was cut down to a minimum. The largest of the girders span 90 feet and are 12 feet deep. They were dispatched by road from the company's workshops at Benoni, where all the steelwork was fabricated. To allow of transportation through Johannesburg, they were split into halves, the halves being welded together at the site and the girders lifted in one piece. A striking feature of the design is the absence of gusset plates and the lightness of all the sections employed. The entire framework is welded, including even the site connexions. The saw-toothed type of roof employed produces excellent internal lighting. The percentage of windows to floor space is about thirty. The lamps provided are of the mercury vapour type. Between 500 and 600 tons of steel were used in the erection of the sheds, the greater portion of this steelwork being produced in South Africa.

Electric Lighting in a Modern Store

IN Welwyn Garden City, Herts, an entirely new building now houses the Welwyn Stores; a description of the building is given in the *Electrical Review* of October 13. The Welwyn Electricity Supply Co. built and equipped a new sub-station near the site to meet the required demand. The G.E.C. Co., Ltd., installed the whole of the lighting and fittings for 336 combined tungsten and Osira lamps. The outside illumination consists of four large neon signs. The shop fronts have artificial stone piers, marble risers and a painted wooden facia and cornice in which is set a line of fluorescent tubing running round three sides of the building. About 900 feet of 'Clora' coated tubing has been used for this purpose. The store itself comprises ground floor and part of the first floor. Under an artificial daylight effect achieved by 'T.O.T.' units, the natural wax-polished oak counters, stock fittings and panelling show up well. During the daytime, the daylight entering the ground floor through 'glass-crete' roof-lights from the staircase blends with the artificial illumination, all strong contrasts being eliminated. Each lighting unit consists of one 80-watt 'Osira' fluorescent type discharge lamp and three 150-watt tungsten lamps enclosed in opal sphere pendants 18-in. in diameter. All the main selling floors have this type of lighting. The food hall is a separate section on the ground floor. There are 1,400 feet of fluorescent tubing, arranged round the ceiling in three parallel rows—one red tube and two blue—and the effect of this diffused brilliance is enhanced by the green and white chequered flooring, the tiled walls and counter fronts, and other modern fittings. Light signalling by pre-arranged combinations of four different colours is used throughout the store for attracting the attention of managers or other persons.

Soil Science at Adelaide

THE Winter School in Soil Science held during August 14–23 at the Waite Agricultural Research Institute, Adelaide, was a signal success. It was sponsored by the Council for Scientific and Industrial Research and the University of Adelaide and met under the chairmanship of Prof. J. A. Prescott. Sixty members attended, all directly engaged in work on soils, and representative of universities, State departments of agriculture and of forestry, water supply commissions, Government chemical laboratories and other interests. Papers were presented on classification, physical composition, colour, water relations, acidity and lime requirement of soils; methods of soil surveying and utilization of soil maps and data; spectrochemical and polarographic methods of analysis; methods for determination of soil carbon, soil reaction and soluble salts; the erosion problem in pastoral areas; and other topics. Numerous demonstrations were arranged. As a result of the School, soil investigators throughout the Commonwealth will in future be working in more intimate association and along more uniform lines.

Rare Medical Books

ON the occasion of the seventieth birthday earlier this year of the late Prof. Harvey Cushing, Schuman's of New York brought out, under the title of "Seventy Noteworthy Medical Rarities", an illustrated and annotated catalogue to which are prefixed a portrait of Dr. Cushing, taken about forty years ago, and an appreciation of the eminent surgeon and bibliophile by Dr. Lawrence Reynolds. Among the notable works listed in the

catalogue may be mentioned a thirteenth century medical manuscript on vellum containing some of the works of Constantinus Africanus, Giles of Corbeil and others, the work of Bartholomaeus Anglicus entitled "De Proprietatibus Rerum" (1535), Ambroise Paré's "Dix Livres de la Chirurgie" (1564), Gasparo Aselli's book on the lacteals (1627), Robert Boyle's "Sceptical Chymist" (1661) and modern works by Oliver Wendell Holmes, Sir William Osler and S. Weir Mitchell.

The Science Library

THE Science Library, Science Museum, South Kensington, is remaining open. Books and periodicals are available for consultation in the reading room and for external loan to institutions engaged on research work. A relatively small number of the older books and periodicals have been removed and are not at present available. Although difficulty is anticipated, every endeavour will be made to maintain the collection of important current foreign scientific and technical literature up to the pre-war degree of completeness. The bibliographical and information service of the Library will be maintained so far as the reduced resources permit.

Royal Astronomical Society

THE meetings of the Royal Astronomical Society will continue to be held at Burlington House, London, but at an earlier hour. The *Monthly Notices* and also *Occasional Notes* will be published so far as possible, but the former will not necessarily appear each month. The library will be closed except on meeting days, as the assistant secretary and office have been transferred to Oxford. The Christmas lecture, soirées, etc., have been postponed indefinitely. Prof. H. H. Plaskett, the senior secretary, is serving in the Royal Artillery, and Prof. W. M. H. Greaves has been appointed acting secretary for the present.

British Astronomical Association

THE annual general meeting of the British Astronomical Association will be held as usual on October 25, in accordance with the articles of the Association, and no arrangement has been made at present to alter procedure in the matter of ordinary meetings. The president, two secretaries and treasurer have been empowered to conduct the business of the Association if war-time emergency should cause a discontinuance of the meetings. If this contingency arises, the *Journal* will still be published monthly, and it is hoped that papers will be contributed as usual by members. The library will be open only on the second and fourth Wednesdays of each month, but the librarian has power to refrain from opening in case of emergency.

Institute of Physics

THE offices of the Institute of Physics have been transferred to the University of Reading, where accommodation had been reserved for them, by the kindness of the Council of the University. It is hoped to carry on so far as possible the normal work of the Institute, with such further activities as may be necessitated by emergency conditions. The Institute is in touch with Government departments and other employers, and has been collecting and collating such information as is available regarding the employment of physicists during war conditions. A considerable number of inquiries for advice on this and other emergency matters have received attention. It has been decided, unless unpredictable circumstances intervene, to continue the publication and distribution of the *Journal of Scientific Instruments* on the same terms as in the past, though it may be necessary to reduce to some extent the number of pages in each issue.

Announcements

DR. IAN GALLOWAY has been appointed scientific superintendent of research at the Pirbright Research Station of the Foot-and-Mouth Disease Research Committee.

DR. S. C. HARLAND has been appointed director of the Institute of Cotton Technology of the National Agricultural Society of Peru.

SIR FREDERICK MENZIES has resigned his position as medical officer of health and school medical officer of the London County Council, and has been succeeded by Dr. William Allen Daley.

IN the hope of giving assistance to students in London who have been unable to follow their university colleges into the provinces in the present emergency, the managers of the Royal Institution have arranged for additional short courses of lectures to be given dealing in an introductory manner with certain subjects of modern physics and chemistry. Applications should be made to the Royal Institution, 21 Albemarle Street, London, W.1.

IT is hoped to arrange day and/or evening courses in electrical methods of chemical analysis, microchemical analysis, spectroscopy and bacteriology at the Sir John Cass Technical Institute. Those wishing to take classes in these subjects should write, stating possible days and hours of attendance, to Dr. E. de Barry Barnett, Sir John Cass Technical Institute, Jewry Street, London, E.C.3.

THE governing body of the British Medical Postgraduate School has decided to carry on postgraduate instruction for the present.

OWING to the war, the International League against Rheumatism will no longer be able to carry out its activities, and its bureau at Keizergracht 489, Amsterdam, will be closed.

EIGHTEEN cases of smallpox were notified in England in 1938, of which nine were variola major and nine variola minor, and there were three deaths. These are the first deaths from smallpox which have occurred in England since 1934.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 713.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Kinematical Relativity and the Geological Time-Scale

IN a recent paper, a detailed analytical theory of time-keeping has been developed on an axiomatic basis[1]. Starting from the existence of a temporal sequence for events at any given observer and the existence of a 'substratum of equivalent observers', it has been found that amongst all possible graduations of the clocks of a substratum two families stand out with special properties, namely, the family τ, according to which the substratum is described by each of its members as static, and the family t, according to which it is described as uniformally expanding from a point origin. By deriving the equation of motion of a free particle, it has been found that if we identify the smoothed-out universe of extra-galactic nebulæ with a substratum, then the uniform time of dynamics is to be identified with τ-time[2], which gives an infinite 'age' to the universe, whereas the uniform time of optics and atomic vibrators is to be identified with a t-time[3], which gives 2×10^9 years as the 'age of the universe'.

It is well known that this 'age of the universe', as derived from Hubble's law, is of the same order as the 'age' assigned to the oldest rocks on the earth's surface by analysis of their uranium-lead ratio. This result, by itself, cannot be taken as conclusive evidence that this is the earth's 'age' because, as Holmes remarks[4], "Hutton's oft-quoted dictum that he could find 'no vestige of a beginning' remains true of geology to this day. Geological time dates from the deposition of the oldest known sediments, and whatever their age may be that of the earth must be still greater". However, strong corroborative evidence for the significance of this figure comes from recent investigations of the helium ratio of iron meteorites, about 70 per cent of which are now believed to reach our planet from outside the solar system[5]. These again lead to a greatest 'age' of the order 2×10^9 years.

These investigations of rocks and meteorites are based on the Rutherford-Soddy law of radioactive decay, which states that if N is the number of atoms of a particular radioactive element present in a specimen at a given epoch, and if δN is the number of these atoms which disintegrate in the subsequent interval δt, then

$$-\delta N = \lambda N \delta t,$$

where λ has been found to be independent of temperature, pressure, etc. 'Ages' are then assigned by this law on the 'assumption' that λ is invariant for change of epoch. This, of course, is simply a *definition* of the particular uniform time of radioactive decay of a given element. Since different elements and methods lead to consistent results, we have good reason for believing that there is a unique uniform time of radioactive decay, and the agreement between the 'ages' assigned to the oldest rocks and meteorites with the 'age' assigned to the universe by Hubble's law makes it extremely plausible to identify this time with the uniform t-time of optics.

If, therefore, we regard the dates assigned to geological epochs as t-scale dates, it becomes of interest to compare them with the corresponding dates on the τ-scale, given by[6]

$$\tau = t_0 \log (t/t_0) + t_0,$$

where t_0 is the present t-epoch, since this is the scale which has been identified with the uniform time of dynamics. It is readily seen that if t_1 is any past t-epoch and τ_1 is the corresponding τ-epoch (the two scales agree on the value of the present epoch, t_0) then

$$t_0 - \tau_1 = t_0 \log (t_0/t_1).$$

We can, therefore, immediately compile the following table to illustrate the difference between the t- and τ-periods assigned to geological eras, all figures being in millions of years.

Geological period	t_1	$t_0 - t_1$	$t_0 - \tau_1$
Present	2,000	0	0
Base of Eocence Rocks	1,930	70	71
Base of Cretaceous Rocks	1,900	100	102
Base of Triassic Rocks	1,800	200	210
Base of Devonian rocks	1,700	300	325
Base of Ordovician rocks	1,600	400	445
Base of Cambrian rocks	1,500	500	575
Laurentian rocks	1,000	1,000	1,400
Oldest European rocks	500	1,500	2,800
Oldest rocks (Manitoba)	250	1,750	4,200
'Creation'	0	2,000	∞

We observe that the t- and τ-measures of the whole fossil period (Cambrian age to present) differ by about 15 per cent of the t-measure, which is not much greater than the probable error in assigning epochs by the present radioactive methods. Moreover, when we go back a thousand million years on the t-scale, that is half way back to 'creation', we find that the τ-measure of this period is not more than fourteen hundred million years.

G. J. WHITROW.

Christ Church, Oxford.
Sept. 21.

[1] Milne, E. A., and Whitrow, G. J., *Z. Astrophys.*, **15**, 263 (1938).
[2] Milne, E. A., *Proc. Roy. Soc.*, A, **154**, 69 (1936); **157**, 324 (1937).
[3] Whitrow, G. J., *Quart. J. Math. (Oxford)*, **7**, 271 (1936).
[4] Holmes, A., "The Age of the Earth", 30 (1937).
[5] Holmes, A., "The Age of the Earth", 230.
[6] Milne, E. A., *Proc. Roy. Soc.*, A, **158**, 337 (1937).

Fission of Uranium under Deuteron Bombardment

Since the phenomenon of neutron-induced fission of the uranium and thorium nuclei is now indisputably established, attention may be turned to the possible efficacy of other bombarding particles in this respect. An outline is here presented of evidence suggesting that high-energy deuterons are, in fact, capable of producing fission in uranium.

The following experimental arrangement has been used. One inside surface of a copper box is covered with a 20 mgm./cm.² layer of uranium metal, and is bombarded by deuterons passing through an aperture in the opposite side of the box. An inside pocket on one of the other walls contains metal foils for the purpose of collecting particles projected from the target through an aperture in the pocket. A thickness of 2 mm. S.P. aluminium is always present to protect the collecting foil from the low-energy products due to mechanical disintegration of the target. Bombardments of about 1 μamp. for ten minutes are convenient, and are found to produce on the collector activities of intensity suitable for measuring with a Geiger counter.

It is necessary to estimate what part of the activity on the collector is due to general neutron radiation and to deuterons scattered from the target. In the pocket are placed three foils of 3·3 mgm./cm.² aluminium, *F*, *D* and *N* in order of proximity to the target, and a single thickness of half-millimetre copper sheet between the foils *D* and *N*. Five minutes after a 4 μamp./min. bombardment with 9 Mv. deuterons, it is found that the neutron effect of the irradiation has produced in *N* a small activity of 40 counts per minute; the neutron effect is eliminated from *D* and *F* simply by subtraction of this *N* effect. *D*'s activity measures the scattered-deuteron effect and is initially about 100 counts per minute, decaying with a half-life of 2·3 min. to reach a negligibly small value after 20 min. *F*'s activity, however, is about 1,500 counts per min., and is much longer-lived, although with a target entirely of lead, *F* as well as *D* shows only a *D* effect.

The decay curve for *F*'s activity has been followed for about 7 hours and has been compared with that calculated from Frisch's formula[1] for the decay of multiplex activity. The measure of agreement is so substantial as to preclude the possibility of a merely accidental coincidence.

A stack of six 0·66 mgm./cm.² aluminium foils has been placed in the pocket and after the lapse of 30 minutes (when the *D* effect has decayed) the activities are found to decrease regularly through the stack, reaching inappreciably small values in the fifth and sixth foils. Regarding another aspect, the fact that replacement of aluminium as the collector material by silver causes no significant difference in the decay curve, suggests that the activity has been implanted rather than induced. The evidence thus indicates that radioactive nuclei are projected from the uranium target with a range of the order of 2 cm.; this occurrence is evidently to be ascribed to a fission of the uranium nucleus.

It is important to assess the magnitude of the fission effect caused by background neutron radiation, and for this purpose there has been enclosed in the pocket itself a layer of uranium, separated from *F* by 2 mm. S.P. of aluminium, and from the target by the copper sheet, this arrangement necessarily reproducing fairly closely that activity in *F* which is due to neutron-induced fission. The intensity in this case is less than one twentieth of that observed in the positive experiment.

Approximate measurements have been made on the excitation function for deuteron-induced fission, using aluminium absorbers to modify the energy of the beam and a suitable disposition of diaphragms to protect the collector against deuterons scattered from the absorbers. The threshold for the process appears to lie at about 8 Mv., and the cross-section increases rapidly in the range 8–9 Mv.

The conclusions drawn from these preliminary experiments would receive unequivocal confirmation from a chemical identification of the fragment nuclei or a detection of their large ionization impulses in an ionization chamber. It might also prove profitable to examine the effects given by others of the heaviest elements (especially thorium).

Dr. R. S. Krishnan and other colleagues of the Cavendish cyclotron group have rendered me indispensable assistance, and I am indebted also to Prof. J. D. Cockcroft for pertinent suggestions.

Cavendish Laboratory, Cambridge. Aug. 26. D. H. T. Gant.

[1] Nature, **143**, 852 (1939).

Absorption of Polymolecular Films in the Infra-Red

The use of infra-red absorption spectra as a means of investigating molecular structure has still to be extended to surface films. Until very recently, the possibilities of this extension seemed remote, since a monomolecular layer does not contain enough molecules per square centimetre to produce measurable absorption. Thus it is found experimentally that approximately 10^{19} molecules are required to produce appreciable absorption in a beam of 1 sq. cm. cross-section, whereas the number of molecules per square centimetre in a monomolecular layer is about 5×10^{14}. With the production of polymolecular films close to 1,000 molecules thick, the possibility of detecting absorption still seemed slight, but technically feasible, if a method employing several reflections through such a film were employed.

As a matter of interest, it was decided to try whether any absorption could be detected using a single reflection through a film of methyl stearate 700 molecules thick, deposited on a chromium-plated strip of metal. We were surprised to find that the well-known absorption at 3·3 μ due to CH groups was easily detectable, showing about 30 per cent absorption, while other weaker bands were noticeable between 6 μ and 10 μ. Next, a film only 200 molecules thick was tried. This still gave the 3·3 μ band with appreciable intensity. These results mean that absorption spectra were being obtained from approximately 10^{17} molecules, instead of the customary 10^{19}. In other words, the absorption coefficient of a molecule in the infra-red seems to be considerably increased when it is in a surface film.

The possible causes of this will not be discussed here. The purpose of this note is merely to record this fact, which opens up a new and potentially interesting field of research in infra-red spectroscopy and its application to problems of molecular structure. In particular, this may prove to be a very suitable method of studying protein molecules.

We wish to express our thanks to Dr. Stenhagen, who prepared the films.

G. B. B. M. Sutherland.
W. T. Tutte.
Laboratory of Physical Chemistry,
Cambridge. Sept. 1.

Analysis of Varying Sound

THE only reasonable method of frequency analysis applicable to the case of varying sound as yet published is that of Germanšky[1] and Brown[2], using diffraction of light by varying-density sound-film. But the technical difficulties owing to low dispersion seem to prevent further development in practical applications of that method. I have recently used a very simple photographic method of frequency analysis which can be designed so as to satisfy all the requirements met with in the analysis of any sounds or other vibrations.

The essential part of this method is a photographic plate (analysing plate), illustrated in Fig. 1, in which the transmitted light intensity varies as $A + B \sin \frac{2\pi}{d}x$, $(0 < B < A)$, along the x direction in the figure, and the wave-length d varies continuously in the y direction. The incident light intensity is varied according to the sound to be analysed, and a photographic film is moved at constant velocity along the x direction at the back of the analysing plate.

Let the incident light intensity be expressed as $P + Qf(t)$, $(0 < Q|f(t)| < P)$, and the velocity of the film be V; then a point on the moving film receives an amount of light which can be expressed as

$$\int_{-Nd}^{Nd} \left[P + Qf\left(\frac{x-\xi}{V}\right)\right]\left[A + B \sin \frac{2\pi}{d}x\right]dx,$$

where ξ is the co-ordinate of the point at $t = 0$, and $2N$ is the number of waves in the analysing plate. If N is sufficiently large, the above integral reduces to a constant term added to the expression

$$QB\int_{-Nd}^{Nd} f\left(\frac{x-\xi}{V}\right) \sin \frac{2\pi}{d}x\,dx = QB\int_{t_1}^{t_2} f(t) \sin \frac{2\pi}{d}(Vt+\xi)\,dt,$$

which is practically the Fourier component of $f(t)$. On a uniform background, sharp lines, the blackness of which varies sinusoidally, are obtained stroboscopically, one corresponding to each component.

FIG. 1
ANALYSING PLATE

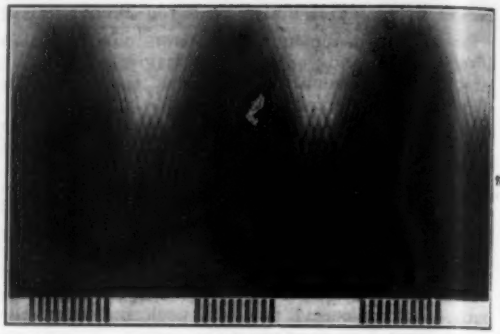


FIG. 2

If the number N is not very large, these lines are broadened to bands, and this broadness limits the resolving power. In the case of varying sound, the variation of the spectrum can be followed by making N sufficiently small, so that the resolving power of frequency and that of time counteract each other. But this is not a defect in the method. The lack of resolving power in frequency is complementary to precise knowledge of time variation, and vice versa.

A simple example is given in Fig. 2, which shows the analysis obtained for the 'square waves' (10 pulses followed by an intermission of 10 periods) shown at the bottom of the figure, n_0 being the fundamental frequency. A preliminary test of the application of this method to the analysis of speech was also undertaken. The variation of word pitch and the crossing of different successive overtones over the formant region of the vowels were clearly observed.

The analysing plate can be modified in various ways for different purposes, Fig. 1 being merely an example. Further, the sinusoidal transmission character of the analysing plate may be generalized to any orthogonal sets of functions, and thus a method is obtained of expanding given functions in series or integrals of some suitable orthogonal functions.

Another application of the analysing plate is found in the artificial composition of sound. By throwing on the plate suitably formed moving rays of light, and receiving the transmitted light on a photo-cell, any desired sound can be produced.

The construction of this analysing apparatus and investigations of some of its applications are now in progress in Prof. Takeo Hori's laboratory. I wish to express my gratitude to Prof. Hori, and also to the Hattori Hokokai for financial support.

KATUMI IMAHORI.

Hokkaido Imperial University,
Sapporo.
July 2.

[1] Germansky, B., *Ann. Phys.*, 7, 453 (1930).
[2] Brown, D., NATURE, 140, 1099 (1937); *Proc. Phys. Soc.*, 51, 244 (1939).

Atomic Parameters of γ-Silver - Cadmium

READJUSTING atomic parameters of γ-brass, we have calculated three successive sets of atomic parameters for γ-silver - cadmium. These sets we tested by comparing the intensities calculated with them with the observed intensities of the reflections of γ-silver - cadmium. For our thrice readjusted atomic parameters, namely, $a = 0{\cdot}105$, $b = 0{\cdot}175$, $c = 0{\cdot}358$, $d = 0{\cdot}310$, and $e = 0{\cdot}038$, the agreement

between the observed and the calculated intensities was sufficiently good to afford confirmation of the correctness of these values. Interatomic distances calculated from these adopted atomic parameters suggests a regular distribution of the silver and the cadmium atoms, silver atoms occupying positions of *B* atoms and *C* atoms, cadmium atoms those of *A* atoms and *D* atoms.

Our calculations were based on powder photographs and the data of reflections made available to us by Prof. A. Westgren of the University of Stockholm. A detailed account of them will be published in the *Acta et Commentationes Universitatis Tartuensis*.

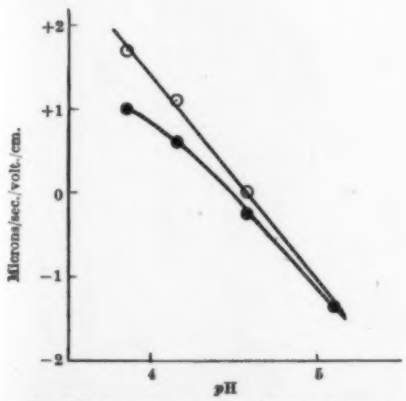
HARALD PERLITZ.
ROLF AAVAKIVI.

Laboratory of Theoretical Physics,
University, Tartu.
Sept. 20.

Cataphoretic Measurements on Solutions of Visual Purple and Indicator Yellow

LIGHT transforms visual purple, the substance responsible for scotopic vision, into a yellow compound, the colour of which depends on *p*H ('indicator yellow'[1]). Visual purple behaves as a coloured protein, that is, it is a 'chromoprotein'. Experiments have been carried out to see if a shift of the isoelectric point occurs on bleaching.

The visual purple was obtained from Hungarian frogs by means of extraction with digitonin, and the solution dialysed for long enough to remove the bulk of the salts, but not to precipitate the protein. Measurements were made with a micro-cataphoretic cell which will be described elsewhere. Quartz particles of the size 2–5 μ were suspended in the solution and *N*/100 acetate buffer added. The particles adsorb the chromoprotein and their movement is governed by the ionization of the latter[2]. The measurements on visual purple were carried out in ruby light to prevent bleaching. After each determination, white light was switched on without removing the cell, so transforming the visual purple into indicator yellow. During the bleaching the cataphoretic velocity of the particles increased in solutions more acid than about *p*H 4·5, and decreased in solutions more alkaline than *p*H 4·5. After a few minutes a steady velocity was reached, which was independent of whether observation was made with ruby or white light.



THE VARIATION OF THE CATAPHORETIC VELOCITIES IN SOLUTIONS OF VISUAL PURPLE AND INDICATOR YELLOW WITH *p*H VALUE

The cataphoretic velocities before and after bleaching for one preparation are plotted against *p*H in the accompanying graph. It appears that the isoelectric point of the particles in the visual purple solution is 4·47, and in the indicator yellow solution 4·57 *p*H units. Other preparations gave the same type of curves and the same shift on bleaching, but sometimes the positions of the isoelectric points were slightly different (±0·1). The isoelectric points are, therefore, in a comparatively strongly acid range. This explains the observation that solutions of visual purple become acid on prolonged dialysis against distilled water[3].

No other case appears to be recorded in literature where moderate illumination produces a change in the isoelectric point of a protein or chromoprotein. The bleaching process of visual purple is apparently associated with an increase in the number of alkaline groups, such as NH_2, available for ionization.

Our thanks are due to the Rockefeller Foundation for financial help.

E. E. BRODA.
C. F. GOODEVE.
R. J. LYTHGOE.
E. VICTOR.

University College,
London.
September 6.

[1] Lythgoe, R. J., *J. Physiol.*, **89**, 331 (1937).
[2] Abramson, H. A., *J. Amer. Chem. Soc.*, **50**, 390 (1928).
[3] Lythgoe, R. J., and Quilliam, J. P., *J. Physiol*, **93**, 24 (1939).

A Mechanism for the Concentrating of Potassium by Cells, with Experimental Verification for Muscle

THE membrane considered is one of special type, with cation and anion pores, permeable to potassium but not to larger sodium ions, and permeable at the same time to small anions of the type of chloride, bicarbonate, phosphate, etc., but not to larger anions such as hexose esters, phosphocreatine, etc. The concentrations inside (or within the cell) and outside the membrane are represented as follows: B/V and b, impermeable cations; k_1 and k, potassium; d_1 and d, permeable anions; A/V, impermeable non-colloidal anions; C/V, colloidal anions inside; x, external impermeable non-electrolyte such as glucose.

The permeable anions, which will be almost entirely chloride and bicarbonate, are considered as monovalent, and the valencies of B, A and C are written as m, n and p. V is the volume of the solvent inside, which is considered to be initially one litre. The quantities A, B and C are regarded as independent of V. The total external concentration is written as 'c'.

From the requirements of the osmotic, electrical and Donnan equilibria we may deduce the following equations:

$$V^2(c^2-4kd)-2VKc+(K^2-K_1^2)=0 \quad . \quad (1)$$

$$2k_1 = c-(K-K_1)/V \quad . \quad (2)$$

$$kd = k_1d_1, \quad . \quad (3)$$

where $$K = B+A, \quad . \quad (4)$$

and $$K_1 = nA+pC-mB. \quad . \quad (5)$$

Reckoning the value of $(K-K_1)$ from the available data, it is found to be sufficiently small to be neglected

in approximate calculations, so that we may write for (1) and (2):

$$V = \frac{2Kc}{c^2 - 4kd} \quad . \quad . \quad . \quad . \quad . \quad (6)$$

$$\text{and} \quad k_1 = c/2, \quad . \quad . \quad . \quad . \quad . \quad (7)$$

From equations 6 and 7 it appears that as potassium is substituted for sodium in the external solution, the potassium concentration in the cell will remain unchanged, but potassium will enter and the cell volume increase. As the external concentration is increased, the potassium concentration inside will increase; but if the external potassium is also raised, the volume will stand higher than otherwise and potassium will have entered the cell.

When excised muscle is immersed in Ringer or Barkan fluid, potassium is lost until the external potassium is 29 milliequiv./litre. The raised equilibrium value appears associated with widening of the cation and anion pores, and it is from this raised value we shall consider the effect of potassium changes. The interspace fluid is taken as 9 ml./100 gm. tissue (from magnesium and inulin methods), though small differences with total volume changes will not materially affect the calculations.

The following table illustrates the kind of results obtained; each figure being the mean of four or five experiments. Concentrations are expressed as milliequiv./litre of external fluid or 'fibre' water (which latter is normally 71 ml./100 gm. muscle).

Potassium conc. in ext. fluid	Total conc. of ext. fluid	Potassium conc. of 'fibre' water		Potassium entry. Milliequiv./litre of 'fibre' water
		Exper.	Theor.	
2·5	240 (plasma)	119	120	
33·5	248	115	124	12·5
103	256	121	128	83·8
103	384	196	192	33·2
103	534	263	267	8·8

For equation 3 we have the following data, taking chloride as an example of the permeable anion.

External conc.		Inside conc.		Products	
K	Cl	K	Cl	K × Cl	K × Cl
29	106	119	26·6	3074	3165
80·4	132	145	73·0	10613	10585

Original entrance of potassium and relation of potassium interchanges to carbohydrate metabolism. Here we shall consider briefly an apparently easy and effective means of increasing the potassium in cells without change in external potassium or in total concentration outside. If, in the above scheme, impermeable anions are formed from permeable, V the volume of the cell will increase from equation 6, and potassium and more diffusible anion will enter the cell in accordance with equations 3, 2 or 7. No intermediation of hydrogen ion with its excessively low gradients will be necessary. A permeable anion that could play this part pre-eminently is phosphate, and when we examine the nature of the impermeable non-colloidal anions within the fibre we find that they are mostly if not quite formed of phosphorylated compounds important for the carbohydrate cycle. If such compounds decrease in concentration during rapid carbohydrate oxidation, potassium should leave the cell, and when reformed the reverse should occur. A relation between carbohydrate metabolism and potassium interchanges has, in fact, been already noted (for example, by Verzar) and is here rationally interpreted.

With the above membrane the potential changes with varying external solutions can also be readily understood, previous explanations assuming chloride impermeability being demonstrably incorrect.

The above research was supported by a grant from the Irish Medical Research Council.

E. J. CONWAY.
P. J. BOYLE.
University College,
Dublin.
Sept. 1.

Action Potentials Recorded from Inside a Nerve Fibre

NERVOUS messages are invariably associated with an electrical change known as the action potential. This potential is generally believed to arise at a membrane which is situated between the axoplasm and the external medium. If this theory is correct, it should be possible to record the action potential between an electrode inside a nerve fibre and the conducting fluid outside it. Most nerve fibres are too small for this to be tested directly, but we have recently succeeded in inserting micro-electrodes into the giant axons of squids (*Loligo forbesi*)[1].

The following method was used. A 500 μ axon was partially dissected from the first stellar nerve and cut half through with sharp scissors. A fine cannula was pushed through the cut and tied into the axon with a thread of silk. The cannula was mounted with the axon hanging from it in sea water. The upper part of the axon was illuminated from behind and could be observed from the front and side by means of a system of mirrors and a microscope; the lower part was insulated by oil and could be stimulated electrically. Action potentials were recorded by connecting one amplifier lead to the sea water outside the axon and the other to a micro-electrode which

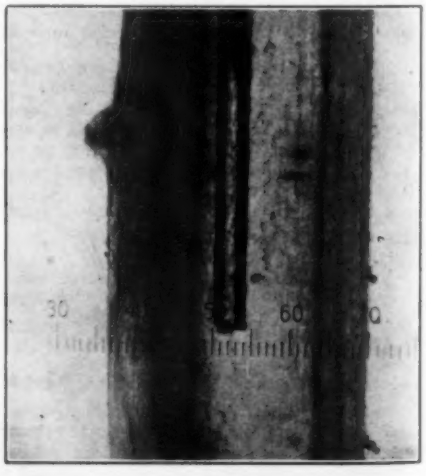


Fig. 1.

PHOTOMICROGRAPH OF ELECTRODE INSIDE GIANT AXON. 1 SCALE DIVISION = 33 μ.

was lowered through the cannula into the intact nerve beneath it. The micro-electrode consisted of a glass tube about 100 μ in diameter and 10–20 mm. in length; the end of the tube was filled with sea water, and electrical contact with this was made by a 20 μ silver wire which was coated with silver chloride at the tip. Fig. 1 is a photograph of an electrode

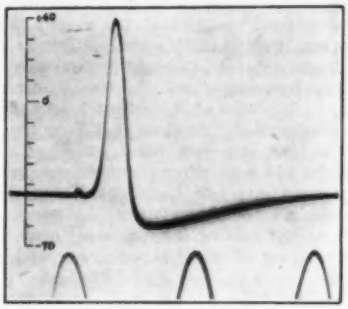


Fig. 2.

ACTION POTENTIAL RECORDED BETWEEN INSIDE AND OUTSIDE OF AXON. TIME MARKER, 500 CYCLES/SEC. THE VERTICAL SCALE INDICATES THE POTENTIAL OF THE INTERNAL ELECTRODE IN MILLIVOLTS, THE SEA WATER OUTSIDE BEING TAKEN AT ZERO POTENTIAL.

inside the living axon. The giant axon shows as a clear space and is surrounded by the small fibres and connective tissue which make up the rest of the nerve trunk. The silver wire can be seen inside the electrode and about 1 mm. from its tip. A small action potential was recorded from the upper end of the axon and this gradually increased as the electrode was lowered, until it reached a constant amplitude of 80–95 mv. at a distance of about 10 mm. from the cannula. In this region the axon appeared to be in a completely normal condition, for it survived and transmitted impulses for several hours. Experiments with external electrodes showed that the action potential was conducted for at least a centimetre past the tip of the micro-electrode.

These results are important for two reasons. In the first place they prove that the action potential arises at the surface, and in the second, they give the absolute magnitude of the action potential as about 90 mv. at 20° C. Previous measurements have always been made with external electrodes and give values which are reduced by the short-circuiting effect of the fluid outside the nerve fibre.

The potential difference recorded between the interior and exterior of the resting fibre is about 50 mv. The potential difference across the membrane may be greater than this, because there may be a junction potential between the axoplasm and the sea water in the tip of the electrode. This potential cannot be estimated, because the anions inside the nerve fibre have not been identified.

We wish to express our indebtedness to Mr. J. Z. Young, whose discovery of the giant axon in *Loligo* made this work possible.

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[1] Young, J. Z., *Proc. Roy. Soc.*, B, 121, 319 (1936).

Legume Nodule Metabolism and Nitrogen Fixation

THE extent of nitrogen fixation in legume nodules is governed primarily by the carbohydrate supply[1,2]. Quantitative information concerning the carbohydrate and nitrogen metabolism of nodules is, however, somewhat limited. Investigations of this subject, conducted during the past four years, are here reported upon briefly.

The experimental procedure involved the use of standard manometric techniques supplemented by chemical analyses. Nodules from twelve species of legumes were compared with normal root tissues of these legumes and of twelve species of non-legumes. These tissues were detached from young field-grown plants, washed, and used as quickly as feasible in Warburg respiration experiments, or otherwise as desired. The outstanding results of these studies are given below.

Variations in behaviour between samples of nodules of different species were not much greater than between samples of the same species, hence the selection of a species for an experiment was relatively unimportant. The same generalization applies also to root tissues.

The inner tissues of most nodules kept in air were under partially anaerobic conditions; this was likewise true for large nodules even in oxygen. This conclusion is based upon the relative rates of respiration and respiratory quotients of nodules and roots in different partial pressures of oxygen. In air, the average Q_{O_2} of whole legume nodules and small roots of legumes and non-legumes was about 2·2; the values for nodules immediately after crushing usually varied between 3 and 7. The use of pure oxygen increased the average Q_{O_2} of whole nodules to about 5·3, but changed that of small roots only slightly. Small root tissues are evidently well aerated, even in air. The *R. Q.* values of nodules increased with nodule size and with decrease in oxygen concentration. In air most nodules, even though small, showed *R. Q.* values considerably above 1·0, whereas in pure oxygen the values were usually near 1·0. Small legume and non-legume roots usually gave values appreciably below 1·0 even in air.

Small roots apparently contain less available carbohydrates than do nodules, since glucose additions increased the Q_{O_2} of the former about 40 per cent and of the latter 12 per cent. The smaller diameter of the roots, however, favoured sugar penetration, and this fact may account for a portion of the greater increase. Under anaerobic or partially anaerobic conditions both nodule and root tissues formed ethyl alcohol[3]; under aerobic conditions alcohol was oxidized completely to carbon dioxide and water.

The rates of respiration per unit of tissue nitrogen of legume and non-legume roots was 3–4 times as great as for nodules in air, and twice as great as for nodules in oxygen. This indicates that a considerable portion of the nitrogen in nodules is either in storage, translocatory or other biologically inactive compounds.

Repeated attempts to obtain nitrogen fixation by detached nodules of different species and ages and maintained under various conditions were, with one possible exception, unsuccessful. Nitrogen analyses were made either by the Kjeldahl method or by gas analysis.

These experimental results are in harmony with the generally accepted idea that the bacteria in nodules are mostly in a dormant condition. Under ordinary atmospheric conditions the Q_{O_2} of nodule

tissue was not greatly different from that of young root tissues, and the average respiration rate of the bacteria corresponded to or was even lower than that of resting rhizobia (Q_{O_2} usually about 6–8) in culture. Considering, furthermore, that nodules usually represent only 1–5 per cent of the total dry weight of the plant, it is obvious that the bacteria in the nodules oxidize only a small portion (see earlier discussion[1]) of the carbohydrate synthesized by the host plant. The bulk of the carbohydrate supply that largely determines the magnitude of nitrogen fixation is actually used by the host in its growth processes.

A detailed account of these investigations will be published shortly in a series of papers.

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[1] Allison, *Soil Sci.*, **39**, 123–143 (1935).
[2] Allison and Ludwig, *J. Amer. Soc. Agron.*, **31**, 149–158 (1939).
[3] Ludwig, Allison, Hoover and Minor, "Incidental Observations Regarding the Production and Utilization of Alcohol by Plant Tissues". *Science*. In the press.

Correlation between Seed Weight and 'Adult' Weight in Tomatoes

IN a recent contribution to the study of heterosis, Luckwill[1] adduces evidence that in different crosses of tomatoes hybrid vigour may appear at different stages in the life-cycle. He states that in certain crosses "there was found to be very little correspondence between the presence of heterosis in the seed and in the mature hybrid". A possible reason for this, as Luckwill mentions, is that seed size is influenced by other than genetic causes, but there is another explanation which has been overlooked, and which is important in all such studies of plant growth.

In Luckwill's experiments seeds of known weight were planted in pots, and were afterwards transplanted "with the greatest possible care" into garden plots. Luckwill assumes that the disturbance in growth due to transplanting does not interfere with any correlation between seed weight and adult weight, and that if seed weight is important in determining size, larger seeds should give rise to larger plants, notwithstanding this treatment. The following data show that this assumption is incorrect.

COVARIANCE OF SEED WEIGHT AND ADULT WEIGHT FOR TEN STRAINS OF TOMATOES, BETWEEN MEANS OF STRAINS.

Treatment	Degrees of freedom	Sums of products	r
Transplanted	9	18·8193	0·503, not significant
Control	9	28·7683	0·949, significant

Weighed seed of ten strains of tomatoes (five inbred lines and five F_1 crosses) were planted in uniform conditions in a greenhouse. After an interval of 31 days half the seedlings were transplanted with great care into ten-inch pots. The other half remained in the ten-inch pots in which they had germinated. The transplanted and control seedlings were arranged in blocks in a greenhouse, to facilitate statistical analysis. On the 78th day after germination, as the first flowering truss appeared, the plants were harvested, dried in a stream of air at 95°, and weighed. The accompanying table shows the result of an analysis of covariance between seed weight and adult weight for the transplanted and control plants.

It is clear that there is a highly significant correlation between seed weight and dry weight at the onset of flowering, and that this correlation is destroyed if the plants are transplanted between sowing and harvesting, however carefully the transplanting is carried out. It seems obvious that Luckwill's method of comparing the significance of differences of means of seed weight on one hand, and of means of fresh weight 145 days after planting, and after transplanting, on the other hand, can give no reliable information as to the relation between seed size (whether in hybrids or inbred lines) and adult size.

A full account of these experiments will shortly be published.

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[1] Luckwill, L. C., *J. Gen.*, **37**, 421 (1939).

Loaded Dice

DICE have been used as a game of chance from time immemorial and have in all ages been associated with gambling for high stakes. Loaded dice or dice adjusted to increase the probability of a particular face or one of a group of faces turning up have been used by swindlers from very early times, and such methods of destroying symmetry as unsymmetrical weighting and slight alteration of form are well known. Even in the case of normal dice, the method of numbering the sides may cause a slight departure from perfect symmetry, and there may be justification for the alleged belief of professional gamblers that there is a slight tendency for the higher numbers 4, 5 and 6 to turn up more often than 1, 2 and 3.

Dice are numbered in such a way that the sum of the numbers on opposite sides is always 7. There are two possible arrangements which are mirror images of each other, but I do not know whether both are used. The numbers 1, 2 and 3 are grouped around one corner of the cube and the opposite numbers 6, 5 and 4 around the diametrically opposite corner. It follows that if conical or hemispherical holes are used for numbers, since more material is removed the higher the number, the centre of gravity will be displaced towards the corner adjoining the three low numbers, and there should in consequence be a slight bias in favour of the higher numbers turning up, the magnitude of the bias being increased with the size of the holes. There should also be a bias, though very much smaller, in favour of even numbers against odd numbers.

Attempts to detect such a bias by a very large number of throws have, I believe, been recorded, but I am unable to trace such records. Experimental detection of a bias would not show, however, that the bias was due to displacement of the centre of gravity, since another and very important factor is involved, namely, lack of uniformity in the frictional resistance of the surfaces of the die.

In professional gambling, dice are thrown along a plane surface of correct texture such as a billiard table. A die near the end of its course with just sufficient momentum to overturn it, if arrested by the surface will, if its frictional resistance is low, slip forward without overturning, but if sufficiently retarded by friction will turn over on to the next face. The result of this can be more easily seen by considering dice marked, as they frequently are, black and white on opposite faces. If the black faces have low and the white higher frictional resistance, a die on its black face will slip forward and stay on that face when one with the same momentum but on its white face will turn on to one of the four adjoining faces, two of which are white and two black. Assuming that there is equal probability of a die being on any one of its six faces before frictional resistance is operative, friction can thus cause a large bias, of limiting probability 3 to 1 in favour of the die coming to rest with one of the faces of higher resistance on top.

In order to test this effect of frictional resistance, I marked plain, transparent coloured dice of the modern type with a small black dot on three adjoining faces and a small white dot on the three opposite faces, and treated the faces having black dots in various ways with the view of increasing resistance to slip without leaving visible signs of treatment. Excellent results were obtained with a specially prepared slow-drying colourless varnish, undetectable by appearance on the treated dice. When the varnish had hardened sufficiently, a slight difference of touch was detectable though not obvious. Numerous trials with treated dice thrown on a suitable surface, best on a billiard table, showed a most pronounced bias in favour of the treated sides with black dots turning up. The bias decreased as the varnish became harder, and was much smaller twenty-four hours later. The following throws made with a single die and grouped into hundreds are typical:

$$\frac{\text{black}}{\text{white}} = \frac{65}{35} + \frac{74}{26} + \frac{69}{31} + \frac{62}{38} + \frac{67}{33} + \frac{69}{31} + \frac{65}{35} + \frac{61}{39} = \frac{1{\cdot}9}{1}$$

If two such dice are thrown, as in a common form of gambling, the probability of a pair of black against a pair of white is $1{\cdot}9^2 = 3{\cdot}6$ to 1.

With ordinary numbered dice with conical or hemispherical holes, it is possible that the frictional resistance may be increased or diminished with the number of holes according as the edges of the holes are sharp or rounded. Consequently, any observed bias cannot be attributed to displacement of centre of gravity unless the possibility of such bias being due to difference of frictional resistance has been eliminated.

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Points from Foregoing Letters

The uniform time of radioactive decay is identified by G. J. Whitrow with the *t*-time of kinematical relativity, according to which the 'age of the universe' is of the order 2×10^9 years. Since this is not the uniform time of dynamics, according to which the 'age of the universe' is infinite, a comparison is made between the dates assigned to various geological epochs by radioactive methods and the corresponding dates in dynamical time. It is found that the two measures of the whole fossil period differ by an amount not much greater than the probable error in estimating its duration by the present methods.

D. H. T. Gant has bombarded uranium with high energy deuterons, and by studying the decay curve of the recoiling fragments he has obtained evidence suggesting that radioactive nuclei are projected from the uranium target with a range of the order of 2 cm., due to a fission of the uranium nucleus. The threshold for the fission process appears to lie at about 8 Mv. and the cross-section increases rapidly in the range 8–9 Mv.

G. B. B. M. Sutherland and W. T. Tutte report that appreciable absorption in the infra-red region of the spectrum between 3μ and 10μ is exhibited by polymolecular films only a few hundred molecules thick. This rather surprising result opens up a new field of research in the application of infra-red spectroscopy to the structure of surface films, and may be of importance in studying protein molecules.

K. Imahori describes a photographic method of frequency analysis which can be applied to sound.

From powder photographs by A. Westgren and H. Ålstrand, H. Perlitz and R. Aavakivi have calculated the atomic parameters of γ-silver - cadmium, finding by the method of successive approximations values which gave calculated intensities in good agreement with those observed experimentally.

E. E. Broda, C. F. Goodeve, R. J. Lythgoe and E. Victor find that the iso-electric point of visual purple is 4·47 *p*H units, and that it undergoes a shift by 0·1 *p*H units to the alkaline side on bleaching to indicator yellow. This is taken to suggest that bleaching results in an increase to the number of alkaline groups available for ionization.

A special type of cell membrane is dealt with by E. J. Conway and P. J. Boyle which is both anion- and cation-permeable up to certain size limits of the ions. Potassium, for example, is considered permeable and sodium impermeable. In contact with ionic media like blood plasma, such a membrane will result in a high internal potassium concentration being in equilibrium with a low value outside, and certain relationships can be deduced which are shown to apply to excised muscle. A relation with carbohydrate metabolism, and the manner of the original entrance of potassium into cells, are suggested.

A. L. Hodgkin and A. F. Huxley describe a method for inserting an electrode into a living nerve fibre. They have recorded action potentials of 90 mv. across the surface of the fibre.

Respiration studies made by F. E. Allison *et al.* show that the inner tissues of legume root nodules are usually partially anaerobic. Both nodule and root tissues may produce or oxidize ethyl alcohol, depending upon the oxygen supply. The rates of carbohydrate consumption under ordinary atmospheric conditions by nodule and young root tissues are usually about the same. Attempts to obtain nitrogen fixation by detached nodules were unsuccessful.

RESEARCH ITEMS

Blood Groups among Primitive Peoples

The British Association Research Committee on Blood Groups among Primitive Peoples, of which Prof. H. J. Fleure is chairman, reported at the Dundee meeting on its work during the year 1938–39. Results obtained by Dr. F. W. Vint in Nairobi, Kenya, in 1936, which it has not been possible to carry further, are recorded as follows: Individuals tested, 121 (Bantu, 73; half-Hamites, 5; Nilote, 33; mixed, 10); percentages: *O*, 42·1; *A*, 22·3; *B*, 30·6; *AB*, 5. In the Naga Hills, Assam, from observations in 1936–37, 407 tests were made in all. Of these 140 were of Angamis, Lhotas, Rengmas, and Semas, known historically to be of similar stock. They gave the percentages, Angamis, *O*, 35·4, *A*, 34·4; *B*, 25·0; *AB*, 5·2; while all four tribes together gave, *O*, 40; *A*, 33·6; *B*, 22·1; *AB*, 4·3. The percentages for the four tribes together do not differ appreciably from those for the Angami alone. Larger numbers are required to determine whether Semas, Lhotas and Rengmas show significant differences. Three other tribes were tested as follows: Konyaks (127): *O*, 45·7; *A*, 40·2; *B*, 10·2; *AB*, 3·9; Aos (57): *O*, 47·4; *A*, 22·8; *B*, 22·8; *AB*, 7·0; Thado Kuki (83): *O*, 19·3; *A*, 30·1; *B*, 32·5; *AB*, 18·1. These results accord with the view of Mr. J. P. Mills that the Konyaks are more primitive than the Angami-Rengma, that the Konyak and Aos have much more in common, and that the Thado Kuki are an entirely different race. The Konyak and Aos may be regarded as the most primitive in blood grouping. In Travancore 171 Kannikars, as well as Pulayas and other tribes, have been tested with results markedly different from the general population of Trivandrum. Anthropometric measurements and blood group tests have been carried out on 1,000 Egyptians of the Sharqiya Province, Upper Egypt; and 300 tests have been made in Co. Antrim, Northern Ireland, on individuals with a residential history in the district of three generations, to show whether local differences can arise in a small isolated population.

Alsea Ethnography

The Alsea, like other coast Oregon groups, have suffered both a decline of their numbers and a shattering of their culture under the impact of white civilization. At the time Philip Drucker collected data of their culture in 1933 (*Univ. California Pub. Amer. Ethnol. and Archæol.*, 35, 7; 1939) three persons only remained cognizant of their languages and customs; and from them these particulars were obtained. The Alsea territory comprised the two short river valleys of the Alsea and the Yaquina, and the ocean frontage between them. Adjoining to the north were the Salishan Tillamook; to the south the linguistically related Siuslaw and Lower Umpqua. They were never numerous. Their culture was definitely peripheral, possessing the broader outlines of Northwest Coast culture, but lacking the refinements of the focal civilization. They were off the main lines of communications, along which many complexes were diffused. They were a fisher folk, their choice of dwelling-sites, their seasonal migrations, and their technological interests reflecting the importance of this pursuit in their lives. Salmon ranked first of the several kinds of fish taken. Dried, it was the mainstay, which provided a winter of leisure to a people lacking a plentiful and easily preserved food source. Other fish and game only supplemented this diet. Of a full list of fishing devices, traps and harpoons were regarded as the most effective. Traps were used in conjunction with weirs. Dip-nets—conical sacks—were used. The salmon club was indispensable. Hunting was considered an adventurous way of supplementing the fish diet. Probably there were many who rarely hunted. Elk were hunted in the fall. Dogs were used to hold the elk at bay until the hunter came up. The paucity of hunting devices emphasizes the lack of interest in any pursuit other than fishing.

Behaviour of Tsetse Flies

Under the title of "Studies in the Physiology and Behaviour of *Glossina morsitans*", R. W. Jack, chief entomologist for Southern Rhodesia, gives a detailed account of observations made upon this species of tsetse fly (Mem. Depart. Agric., Southern Rhodesia, No. 1, 1–203; 1939). It embodies, in the main, the results of laboratory research, but certain field data are also included. It is evident, according to the author, that *Glossina morsitans* can thrive under a relatively wide range of conditions, given an adequate food supply. The only extremes of climatic conditions which might exclude *G. morsitans* from extensive tracts of country appear to be too low a mean temperature, which retards reproduction below the survival limit, and too high a maximum temperature especially if it is associated with an inferior cover of vegetation. Interference with the food supply is undoubtedly the best general method of eradicating this insect. It is possible, and economically feasible, in Southern Rhodesia to clear any kind of country of *G. morsitans*, but only at present at the expense of the wild game. With the object of finding alternative measures which can be used over wide areas, it is necessary to continue both laboratory and field research. Not enough is known to combat the fly in its habitat and at the same time to spare the game. A large proportion of the country in Southern Rhodesia infested with *G. morsitans* is relatively sterile, largely waterless, mostly unfit for Europeans and only capable of supporting a very scattered native population. Such areas constitute the major problem because, unless they can be cleared of the tsetse fly or shut off by an effective barrier, they will remain a constant danger to more valuable land where it may otherwise be possible to control the situation.

Replacement of Fangs in Rattlesnakes

The functional fangs of rattlesnakes are changed or replaced periodically, such replacement occurring whether the discarded fang has been damaged or is still intact. Laurence M. Klauber describes the method of replacement (*Occasional Papers*, No. 5, *San Diego Soc. Nat. Hist.*, Aug. 1939). There are two maxillary fang sockets on each side of the head, and these are used alternately as the site of the functional fang on that side. The next replacement fang always lies behind the vacant socket, in which it becomes anchored by the solidification of a bony

pedestal when the time for replacement arrives. Replacement on the two sides of the head is not synchronous, but at the time of replacement there is a short period when the new fang and the one which will shortly drop out are both functional. Fang change is so frequent that only during the period of most rapid growth in the largest species can a difference in length be detected between a fang and its next replacement. The author also describes and illustrates the method by which the maxillary is rotated so that a fang can be translated from a resting position against the roof of the mouth to a striking or biting position perpendicular thereto. He notes that the fangs are particularly well adapted for biting rather than merely for striking.

Larval Trematodes in Molluscs

AN exhaustive memoir by Dr. Annie Porter on the larval Trematoda found in certain South African Mollusca, with special reference to schistosomiasis, was published in 1938 by the South African Institute for Medical Research (No. 42, 8, Johannesburg). The memoir is zoological, and describes very fully the life-history of *Schistosoma hæmatobium* and *S. mansoni*, their intermediate molluscan hosts, experiments on transmission, and methods of control—an invaluable survey for the medical man and the parasitologist. In South Africa the vectors of *S. hæmatobium* are the snails *Physopsis africana* and *P. globosa*, while *S. mansoni* is carried by *Planorbis* (? *Biomphalaria*) *pfeifferi*, *Physopsis africana* and *Bulinus tropicus* (Cf. Mozley's paper on the freshwater molluscs conveying schistosomiasis in Tanganyika, NATURE, 143, 951; 1939). Dr. Porter was able to obtain all stages of the parasites from egg to adult, and successfully carried out artificial infection of the snails by miracidia, and of rats and puppies by cercariæ obtained from the snails. She also investigated the penetration of the skin by the cercariæ in native children bathing in infested pools. She concluded that persistent education, treatment of sufferers and mollusc control are the most effective methods of reducing the incidence of both urinary and intestinal forms of this terrible disease. Shorter accounts of other species of Schistosoma follow. The greater part of the book is taken up with descriptions of cercariæ, mostly of unknown parentage, collected by the author from South African snails and studied alive. The eighty-one plates drawn from living material are to be commended for their excellence.

Caridea of the John Murray Expedition

SEVEN new species of Caridea have been described by W. T. Calman and eighteen recorded for the first time from the area traversed by the *Mabahiss* (British Museum (Natural History). The John Murray Expedition 1933–34. Scientific Reports, 6, No. 4. Crustacea: Caridea. 1939). Most of the sixty-seven species identified were from deep water and include some particularly interesting forms. One new species of Plesionika, *P. minor*, has epipods on the first two pairs of legs only, thus being intermediate between Plesionika and Parapandalus. *Parapandalus filipes* n.sp. is peculiar in having the fourth and fifth legs very long and of "thread-like tenuity", the propodus being excessively attenuated and the dactylus microscopic. Two new Pontoniids, both found in association with sponges and referred to the genus Periclimenes and to the sub-genus Periclimenœus and Ancylocaris respectively, are very much alike, and the second resembles *Periclimenes* (*Periclimenœus*) *robustus* of Borradaile in its massive claws, the armature of the fingers and the short thick claws of the walking legs. It is possible that Borradaile's species may also be associated with sponges. *Periclimenes* (*Ancylocaris*) *crassipes* is the only one of these three with simple claws on the walking legs, but otherwise resembles the others very closely; this supports the suggestion of Kemp (1923) that Periclimenœus may not deserve to be even a sub-genus. None of the three has a hepatic spine, which seems to be a further reason for placing them together.

Vegetation of a South Westmorland Fell

THE district described by Alwyn Bennett (N. W. Nat. Union Year Book 1936–37, 19–48) lies between Burton-in-Kendal and Hutton Roof, and its chief ecological interest lies in the close proximity of limestone and acid gravel drift. The glacial drifts, formerly covered by oakwoods, are now, as a result of deafforestation and subsequent grazing, largely covered with bracken, which is actively spreading on land gone out of cultivation. Changes in the ground flora consequent upon the eradication of bracken by cutting and burning are outlined. The limestone area shows stages in development of closed communities from bare scree slopes to grassland or gorse scrub. A flora rich in species is present in the deeper crevices of the limestone pavements, which afford protection from grazing and conserve moisture. The filling of the crevices with humus leads finally to the development of grass heath corresponding to that of the scree slopes, which may later be invaded by bracken or juniper. Grazing pressure prevents the final succession to ash wood. Some statements referring to the wider distribution of certain species require correction. *Asplenium viride* is said not to be recorded in Ireland. It occurs in 30 per cent of the Irish vice-counties. *Dryas octopetala* is wrongly stated to occur on Ingleborough, whilst *Actæa spicata* is not, as stated, absent in Westmorland, but is recorded from the same limestone formation within six miles of the area studied.

Principles of Plant Geography

THE wide scope of plant geography and the varied methods of phytogeographical research are summarized by W. B. Turrill in a paper based on a series of lectures delivered at Westfield College (*Kew Bull.*, No. 5; 1939). The distribution of the main types of world vegetation is determined by climatic factors, principally temperature and precipitation, similar climates giving rise to plant communities with similar physiognomy, for example, the Mediterranean macchie and Californian chaparral. The distributional area of cultivated crops is also a valuable indication of natural conditions, and the areas in which they show maximum diversity have been used to determine their centres of origin. Distribution of the taxonomic units is discussed under physiographic, climatic, edaphic, biotic and historical headings. Other "inherent and miscellaneous" factors which influence distribution are cytogenetics (the distribution of polyploids, for example, often differs from that of diploids), plasticity of species, structural adaptations permitting survival of plants during unfavourable seasons, seed and fruit dispersal and seed setting. The last includes internal and external factors such as carbohydrate-nitrogen ratios, photoperiodism, pollination mechanisms, environmental control of seed

ripening and cytogenetic factors for fertility and sterility. Brief reference is made to the determination of past and present migration routes and the theories of continental drift, age and area, and tolerance.

Hot Water Treatment of Iris Bulbs

IT is now a standard practice to heat most kinds of bulbs for three hours in water at 110° F. to combat attacks of eelworm. Iris bulbs have not usually been subject to the pest, but W. Buddin recently described a considerable attack of this plant by the stem eelworm *Anguillulina dipsaci* (*J. Roy. Hort. Soc.*, 64, Pt. 9; September 1939). He applied the usual heat treatment for the comparatively short period of 50 min.; but even this slight operation had the unfortunate result of diminishing the flowering capacity of the bulbs. Exposure to the hot water for 25 min. had little effect upon the bloom, but was of doubtful value for control of the pest. It remains to find a critical length of treatment between 25 and 50 min., where the pest will be controlled, and the flowering not markedly reduced. Lowering of the floral vigour appears to be a direct lethal effect of the hot water, for increased exposure killed the vegetative parts also.

Spiral Structure in *Osmunda regalis*

I. MANTON (*Phil. Trans. Roy. Soc.*, B, 230, 179–215; 1939) shows that the chromosomes of *Osmunda regalis* provide excellent material for the analysis of chromosome behaviour. The haploid number of chromosomes is 22 and all have terminal or subterminal centromeres and are similar in size. The number of coils at the first meiotic division is 4, at the second meiotic division is 8 and during mitosis is between 12 and 16. The coils are in equilibrium and exhibit no signs of torsional strain during meiosis. The author is of the view that the chromosomes exhibit high elasticity. Measurements indicate that the chromosome length remains constant throughout mitosis, but that at leptotene the thread is about 50 per cent longer, and at first meiotic metaphase 33–50 per cent shorter, than at mitosis. A hypothesis utilizing the apparent similarity to a proteinaceous elastic fibre in the α, β and supercontracted state suggests that the straightening of the molecular contractions at leptotene is a causal factor in chromosome-pairing.

Genetic Construction in Triticum

L. SMITH (Univ. Miss. Research Bull., 298; 1939) describes 56 mutants resulting from the X-raying of *Triticum monococcum* var. *vulgare* and var. *flavescens*. Only 9 of these 56 viable mutants had been found in untreated material. Among the genes were some which controlled the development of chlorophyll, of anthers and sporogenesis, while others influenced colour, hairs, stiffness of leaf and other characters. Ninety-seven combinations of genes have shown that there was no linkage between them, while nine pairs are closely linked, four (involving six genes) being very closely linked.

Thermal Properties of Water and Steam

Two papers by N. S. Osborne, H. F. Stimson and D. C. Ginnings (*J. Res. Nat. Bureau of Standards*, 23, 197, 261; 1939) describe measurements of the heat capacity and heat of evaporation of water in the range 0°–100° C., and the calculation of the thermal properties of saturated water and steam. The papers include a careful critical examination of previous work. The second paper contains extensive tables. It may be mentioned that the value for the latent heat of evaporation at 100° found is 2256·30 internat. joules per gm., and that the specific heat values accord better with the results of Rowland, Laby and Hercus, and Jaeger and von Steinwehr, than with those of Callendar and Barnes. The new data affect the accepted values of the saturation properties of water and steam in the whole range up to the critical region.

Vapour Pressures of Sulphuric Acid Solutions

SOLUTIONS of sulphuric acid should be suitable as standards in the isopiestic method of investigating the thermodynamic properties of aqueous solutions in the higher concentration range, and S. Shankman and A. R. Gordon (*J. Amer. Chem. Soc.*, 61, 2370; 1939) describe some measurements of the vapour pressure of sulphuric acid solutions at 25° for concentrations of 2–23 molal by the static method. The results are in good agreement with previous vapour pressure measurements up to 8 molal, and with electromotive force measurements up to 3 molal. At higher concentrations the vapour pressure and electromotive force measurements are in definite disagreement. A possible explanation is that the cell reaction in the case of the electromotive force measurements is not that postulated. The authors have calculated the activity of the water and the activity coefficient of the acid at various round values of the concentrations.

Reinforced Concrete Research

THE eighth of the studies in reinforced concrete made at the Building Research Station (Dept. of Scientific and Industrial Research, Building Research Technical Paper No. 25. H.M. Stationery Office. 1*s.* 3*d.* net) deals with the strength and deformation of reinforced concrete slabs subjected to concentrated loading. Various tests were made on slabs, 6 ft. × 6 ft. × 4 in., 12 ft. × 6 ft. × 4 in. and 6 ft. × 9 in. × 4 in., the concrete mixture in each case being 1 : 2 : 4 by weight, water-cement ratio 0·62 by weight, giving a slump of 1 in. to 1½ in. At low loads, before the incidence of cracking, the slabs deformed in accordance with the theory of the elastic homogeneous plate. After the incidence of cracking under higher loads, considerable redistribution of moments was apparent and the ultimate loads were about twice as great as the values calculated by the elastic theory for square slabs and 1½ times in the case of rectangular slabs. Hence the design of reinforced concrete bridge deck slabs on the usual basis of the elastic theory is conservative for the case of point loading under static conditions, since the high theoretical stresses in the neighbourhood of the load are considerably reduced as a result of plastic deformation at high loads. While this conclusion bears the satisfactory inference that the theory is a safe basis of design, it has been pointed out that the mechanics of slab action after the incidence of cracking are so complex that no alternative method of design is at present suggested. It is also mentioned that in this investigation the deflections of the supporting beams were so small that they were considered as not seriously affecting the moment distributions. In practice, however, the yielding of the supporting beams may be of considerable importance in this respect.

INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS

THE seventh General Assembly of the International Union of Geodesy and Geophysics was held at Washington, D.C., during the period September 4–15, 1939, after the declaration of war upon Germany by Great Britain and France, consequent upon the German invasion of Poland. It was therefore probably the last of the series of great international scientific conferences of the period following upon the War of 1914–18. The choice of Washington as the place of the seventh assembly was made at the sixth assembly, in Edinburgh, in 1936. At Washington the invitation of Norway to the Union, to hold its eighth assembly in that country, was formally accepted, for 1942 or as soon thereafter as conditions in Europe permit. The first five assemblies of the Union were held at Rome, Madrid, Prague, Stockholm and Lisbon.

On August 30, when the political crisis was already nearing its height, the president and secretary of the Union, Dr. D. la Cour (Denmark) and Brigadier H. St. J. L. Winterbotham (Great Britain), after consulting the American Organizing Committee and other colleagues then in Washington, cabled to all adhering organizations intimating that the assembly would be held, but that its activities would be confined to scientific matters only. This last decision was subject to the approval of the executive committee of the Union, and was later agreed to; it was made because many of the expected delegates would be absent from the assembly, either because, having crossed to America, they had been recalled (as was the case with the whole French delegation and many of the British delegates, including most of those in the service of the Government), or, having started, did not proceed to their destination (as happened to the delegation from Germany, with the exception of one member who had travelled earlier to Washington), or had cancelled their journey before leaving. The business thus excluded from the original agenda included the discussion of administrative matters and of the proposed amendments of statutes, and also the election of new officers and executive committees for the Union and its seven associations. The existing officers were continued, as an emergency measure, until such time as a postal ballot seems desirable and feasible. Hence, for the present, the above-mentioned officers of the Union continue in office, as also those of the associations, as follows (P = president, S = secretary): Geodesy: (*P.*) Meinesz (Holland); (*S.*) Perrier* (France). Seismology: (*P.*) Heck (U.S.A.); (*S.*) Rothé* (France). Meteorology: (*P.*) Chapman (Britain); (*S.*) Bjerknes (Norway). Magnetism: (*P.*) Fleming (U.S.A.); (*S.*) Goldie* (Britain). Oceanography: (*P.*) Helland-Hansen (Norway); (*S.*) Proudman (Britain). Volcanology: (*P.*) Michel-Lévy* (France); (*S.*) Signole* (Italy). Hydrology: (*P.*) Lütschy* (Switzerland); (*S.*) Diénert* (France).

The vice-president of the Association of Hydrology, Prof. Slettenmark (Sweden), was present and presided over its meetings; the Association of Volcanology was entirely without officers present, and Dr. L. H. Adams (U.S.A.) was chosen as acting president.

Brigadier Winterbotham returned to England before the assembly opened, and Dr. W. Bowie (president of the Union at the Edinburgh Assembly) was chosen as acting general secretary of the Union; the work of the five absent secretaries of Associations was also undertaken by American delegates.

*These officers were not present.

At present, about thirty-two countries adhere to the Union, and twenty of these were represented at Washington (Argentine, Belgium, Canada, Chile, Columbia, Denmark, Eire, Finland, Germany, Great Britain, Greece, Holland, Japan, Mexico, Norway, Poland, Rumania, Sweden, Switzerland and the U.S.A.). Visitors were present also from Bulgaria, Dominica, Hungary, India, the Philippines and Venezuela (non-member States). The United States naturally provided the largest section of members present, numbering approximately three hundred (with a hundred non-members); the number of other members present was about ninety-five (with about twenty-five non-members); thus the Assembly was one of the largest yet held. The absence of French and Italian delegates (and Russian visitors, as at Edinburgh) was much regretted.

In accordance with the decision not to discuss new administrative questions, the associations adopted no schemes involving new expenditure, and agreed to continue their financial management and programmes along the lines heretofore followed, so far as the available funds allow. Fortunately, the Union (and some of the associations in addition) has accumulated a certain reserve of unexpended money, and with its aid it is hoped that, despite the probable reduction of subscriptions accruing during the next year or two, the work of the Union and its associations can to some extent be continued until peace is restored.

The interest of the United States Government in the Assembly was shown not only by the financial provision which (with other assistance) enabled the American organizing committee (president, Dr. R. M. Field, secretary, Dr. J. A. Fleming) to make the excellent arrangements that helped so much towards the efficient conduct of the meetings. The Government, which during the development of the crisis clearly indicated its wish that the Assembly should be held, showed its good will also by an address of welcome from Mr. Cordell Hull, Secretary of State, at the opening meeting of the Union; moreover, the President, Mr. F. D. Roosevelt, received the Union officers and the presidents of the associations, together with Dr. Field, at the close of the Assembly. The closing words of Mr. Cordell Hull may be quoted here:

"If is my fervent hope, which the people of this country share, that the day may soon come when the statesmen of the world will take a leaf from the book of the scientists and solve international political problems in the same dignified and friendly spirit."

The scientific meetings of the Associations, and of the Union's Inter-Association Commission on Continental and Oceanic Structure (president Dr. Field), were held at the George Washington University, the new and older premises of which, generously placed at the Union's disposal, proved very satisfactory and convenient. The absence of administrative business enabled the full time of the Assembly to be devoted to scientific discussion, including several joint meetings between two or more associations, such as are rendered desirable by the ever more closely interwoven problems in the different departments of geophysics. At the end of the Assembly, when

reports on the work of the seven associations and the Commission were presented, it was on all sides agreed that the scientific discussions had been most useful and successful, and that the Assembly had been as valuable as it was harmonious. Apart from the exchange and clarification of knowledge by the reading and discussion of scientific reports and papers (many of which had been circulated in full or in abstract beforehand), the associations were able to perform useful business in arranging for the continuance, in some cases with useful modifications or extensions, of international enterprises of geophysical importance, which they organize or support. Valuable and instructive scientific excursions, and visits to American scientific institutions, also took place during or before the Assembly.

Personal meetings and discussions between fellow-workers in geophysics, from different countries, form another important contribution which such international assemblies afford to scientific progress. These were facilitated not only by the formal meetings, but also by the public and private hospitality which were dispensed to delegates, with the proverbial American warmth and generosity. Recollection of the kindness thus received from our American hosts will long be treasured in our memories.

The president and general secretary of the Union were honoured during the Assembly by the conferment of the doctorate of the George Washington University.

The Pan American Institute of Geography and History (director, Dr. P. C. Sánchey, Mexico) co-operated with the Union and held three meetings of its executive committee during the Assembly, at which many matters of interest to geodesists and geophysicists were discussed. S. CHAPMAN.

WORK OF THE WATER POLLUTION RESEARCH BOARD

A PART of the programme arranged for the Conference of Delegates of Corresponding Societies during the Dundee meeting of the British Association was a discussion on river pollution. Sir Robert Robertson, chairman of the Water Pollution Board of the Department of Scientific and Industrial Research, had prepared a statement of the work of the Board for presentation to the discussion, from which the following account has been prepared. Details will be found in the reports of the Board published by H.M. Stationery Office.

TRADE EFFLUENTS

Beet-sugar factory effluents. The evil due to these effluents can be avoided by passing the effluents through a biological filter, similar to that used on sewage disposal works. It is also practicable, however, to avoid the discharge of effluent by simple treatment by sedimentation, and addition of small quantities of lime so that the waters can be re-used in the factory.

Milk-factory effluent. This effluent, which is highly polluting and may be inimical to fish-life, since it removes dissolved oxygen from the water, has been demonstrated to be capable of complete purification by two methods: that of biological filtration, in which two percolating filters in series are employed, and the sequence of the two filters is periodically changed, and by the activated sludge process. The former method has been adopted in a number of factories. Fish can live in the treated effluents.

STUDIES OF RIVER POLLUTION

The River Tees. A river was chosen which is substantially unpolluted in its upper reaches, then polluted by sewage from a large town, and finally contaminated by sewage and trade effluents in its estuary. The Tees was formerly an important salmon river; it was found that in their progress down the Tees to the sea the smolts were poisoned in thousands. There has been no study made of a river's life-history so intensive, from the different aspects, chemical, biological, and hydrographical. In the non-tidal reaches the effects of sewage were studied on the chemical composition, and animal and vegetable life of the river, and on the seasonal changes with respect to the self-purification of the river. Similarly, in the estuary, these effects were observed on the composition of the water and estuarine life. An interesting conclusion was reached that the hitherto unsuspected cause of the death of smolts was due to cyanide from the coke-ovens; and methods of avoiding this were suggested, and to some extent have been adopted. This intensive study of a river from source to sea may be taken as an authoritative model for future investigations of other rivers.

The Mersey Estuary. Possibly as a result of its successful investigation of the River Tees, the Board was asked to carry out an investigation on the effect of the discharge of crude sewage from Liverpool and other towns in the district on the presumed silting-up of the estuary of the Mersey. This work, on which a comprehensive report has been made, involved nearly four years investigations by hydrographers, chemists, and biologists, and its findings, which are unequivocal, have been accepted by the interested bodies. It was found that the volume of the estuary is subject to periodical changes, but that the alleged shrinkage in the volume and hardening of the bed could not be attributed to the discharge of sewage into the estuary.

WATER SUPPLY

Two aspects of water supply have engaged the attention of the Board: the base-exchange process for softening water, and the question of prevention of contamination of drinking water by lead.

Base-exchange process. The effect of the various substances used for this process has been examined, and quantitative determinations have been made of the efficiency of the substances on the market, as well as of others, including treated natural clays. A remarkable discovery has been made whereby suitably prepared artificial resins can be used to remove both acidic and basic radicals from water.

Prevention of contamination by lead. A study of

plumbo-solvency is being made with the object of improving large-scale methods of treatment of water. In the meantime, an apparatus has been evolved which on being introduced into a water circuit enables a quantitative measure of the lead present in the water to be obtained.

SEWAGE PURIFICATION

As fundamental knowledge was wanting as to the mechanism of methods of treating sewage, such as the activated sludge process, two groups of workers have been engaged on the chemistry and biology of this problem.

The effect of the air-bubbles, which are an essential part of this process, has been examined by chemical and physico-chemical methods, and the changes which occur in the nitrogen and carbon compounds found in sewage and sewage-sludge have been studied in conjunction with the enzymic activity of bacterial cells.

ROAD DEVELOPMENT IN THE UNITED STATES

MR. E. L. LEEMING, an expert on road construction, has given a description in *Roads and Road Construction*, of October 2, of a motor journey he made recently across the United States from Washington to San Francisco, along the Lincoln Highway. This road is now practically completed.

The first thing which strikes the eye of a road engineer, or a road user, when 'docking' at New York, is the sight of the motor traffic speeding along the overhead 'express highway' parallel with the Hudson River and linking the busiest parts of 'downtown' with Riverside Drive, Bronx and other suburbs. For the rapid movement of people, this artery is just as important to the city as the underground railways are. In Washington, since the economic blizzard of 1929, considerable transformation has taken place. Where streets are wide, many things are possible in the way of accommodating traffic. There is room for parking at the side or in the centre, and it is possible to construct an underpass of one road relative to another. Mr. Leeming saw a scheme of this kind in progress; one road is being carried beneath the other, while the surface of the junction is being arranged as a circle to link the connecting roads.

The Lincoln Highway connects the east coast at New York, where it passes beneath the Hudson River by the new Lincoln tunnel, with the Pacific coast near Portland. The road touches Philadelphia, Pittsburgh, Fort Wayne, south of Chicago, Cedar Rapids (Iowa), thence crossing Nebraska, Wyoming, Idaho and Oregon. At Wyoming the road crosses the 'continental divide' at a height of about 7,000 feet. At Salt Lake City he left the Lincoln Highway (U.S.30) and travelled by U.S.40 to San Francisco. Between Nebraska and Wyoming his average speed was 55 m.p.h. in his Studebaker car and his longest day's run was 610 miles. With daily mileages of 500–600, the number of restrictions or hazards are few. Cyclists and pedestrians are entirely absent, while horse vehicles are very rare.

Some curious notices were observed: "Danger, slippery, beware crickets" (meaning dead grasshoppers). In some of the villages, signs were noticed, such as, "Stop when pedestrians are on the crosswalk", "No overtaking for 700 feet", and so on. Good work is being done in the States in regard to 'safety first' measures by organizing schoolchildren. Selected children are trained as leaders to act as traffic police for the purpose of conducting schoolchildren across the roads to and from school. They carry signs indicating "Stop", and every motorist obeys them. Besides preventing children from being run down on the road, it teaches them to observe habits of 'safety first'. In Salt Lake City, where wide streets occur, parking is arranged with the aid of a special meter mounted on a pedestal opposite each vehicle parked on the slant. This meter is operated by placing a nickel (2½*d.*) for half an hour's parking, two nickels or one dime for an hour, and two dimes for two hours. Within these periods an indicator finger is visible at the top of the meter. The meters are only employed between the hours of 9 a.m. and 6 p.m.

Mr. Leeming's journey back from the Pacific coast to New York was made by air over a route covering the Boulder Dam, Grand Canyon, Texas, Kansas City, St. Louis and Pittsburg. This trip takes about 18 hours flying time, but compared with the journey by road, one does not acquire any intimate knowledge of the continent. The author strongly recommends a road journey across from east to west, by one of the arterial routes, U.S.30, U.S.40 or U.S.50. If it is not practical to hire or share a car, the Greyhound, a motor-bus service, is always running. These buses travel over the whole of the States, day and night, and one can sleep on them in very comfortable reclining chairs, if time has to be saved. The cost appears to be much less than that of the rail services. While the latter cost 90 dollars return from New York to San Francisco (without extras), the bus services cost about 65 dollars (about £14) for some 6,000 miles. These buses travel along the highways at about 50–60 m.p.h. and make very good progress.

Some indication of the programme of road development which is likely to be followed in the future is given in the General Motors Exhibition at the New York World Fair. Before making the tour, on the moving chairs of the panorama depicting the highways of America in 1940 gradually changing into the highways of 1960, you are shown a large map of the United States on the ceiling. By an arrangement of the lighting the existing roads are replaced by the new system of modern highroads which will cover the whole continent. Mr. Leeming was informed in Washington that there is enough road development work progressing in the States to keep them busy for the next two generations. Taking into account the remarkable progress which America has already made in road planning, bridge construction and the provision of flyover junctions, he has no doubt that the scheme outlined at the World Fair will be brought to fruition within the period contemplated.

SCIENCE NEWS A CENTURY AGO

Artesian Well in Paris

IN the *Athenæum* of October 26, 1839, it is stated that: "At a late sitting of the Academy of Sciences M. Arago stated that he had that morning been making some thermometrical experiments at the artesian well at Grenelle, in order to ascertain the temperature at the depth which had already been attained, viz., 483 metres or 1584 feet. When the workmen had reached 466 metres the chalk was of a green colour, indicating the proximity of water. Since then the chalk had become mixed with clay, and of a dark colour, a still stronger indication that the sheet of water which it intended to meet is near. M. Arago used the thermometer of M. Walferdin, and after having taken all the precautions in order that the pressure which at such a height is equal to 50 atmospheres would not injure the bulb, six thermometers of the same kind were successively let down to a depth of 481 metres, care having been taken not to lower them until 36 hours had elapsed since the boring, in order that the heat which this work might have communicated should have subsided. The thermometers were left in the well for thirty-six hours. The heat at this depth was 27° of Réaumur, or 92¼° of Fahrenheit, being about 23 metres for each degree of temperature. M. Arago expressed a hope that no water might be found for a hundred metres more, as in that case there would be a permanent hot spring at the very gates of Paris."

The well was ultimately driven to a depth of 547 metres. A monument which existed at this spot was demolished in 1904 and a statue of Pasteur erected in its place.

Dye-Wood

THE issue of the *Athenæum* of October 26, 1839, contains the following note: "A method of extracting the colouring matter from wood has been lately employed by a M. Besseyre with much success. He first reduces the woods to very small divisions, and then immediately places them in a closed vessel exposed to a current of steam. When the whole has attained 80 degrees of heat, it is uncovered and watered with several pints of cold water. By means of a tap below the condensed liquid is drawn off, and thrown back upon the chips, and the operation is repeated until the dye has acquired sufficient strength."

Edward Cowper at King's College, London

"ON Monday last," said the *Mechanics' Magazine* of October 26, 1839, "a new and very important class of manufacturing art and machinery was opened to the students of this institution by Mr. Edward Cowper." The objects of the lectures and instruction were to familiarize students with machinery in actual use, and students were to make experiments themselves and also visit factories and works accompanied by the lecturer.

Edward Cowper, who was born in 1790 and died in 1852, was well known for his important inventions in connexion with printing machinery. With Augustus Applegarth (1790–1871) in 1827 he invented the four-cylinder machine which superseded the Koenig machine for printing *The Times*. His son, Edward Alfred Cowper (1820–93), the inventor of the hot-blast stove, was in 1880–81 president of the Institution of Mechanical Engineers.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

ASSISTANT I in the Directorate of Communications Development—The Under-Secretary of State, Air Ministry, Dept. ZA. (B.127), Harrogate, Yorks (quoting B.403) (October 27).

BOROUGH ENGINEER AND SURVEYOR of the Metropolitan Borough of Stepney—The Town Clerk, Municipal Offices, Raine Street, E.1. (October 30).

LECTURER IN PHARMACY in the Department of Chemistry of the Witwatersrand Technical College, Johannesburg—Frank Ross and Co., 9 Fenchurch Avenue, E.C.3 (November 1).

PROFESSOR OF CHEMISTRY and a PROFESSOR OF BIOCHEMISTRY—The Registrar, Indian Institute of Science, Bangalore, India (December 15).

LECTURER (WOMAN) IN MATHEMATICS—The Principal, Training College, Lincoln.

ASSISTANTS GRADE I (Ref. A.001), ASSISTANTS GRADE II (Ref. A.002), and ASSISTANTS GRADE III (Ref. A.003)—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Ministry of Agriculture and Fisheries. Agricultural Statistics, 1938. Vol. 73, Part 1: Acreage and Production of Crops, Number of Live Stock and of Agricultural Workers, and Output and Prices of Agricultural Produce in England and Wales. Pp. 113. (London: H.M. Stationery Office.) 1s. 6d. net. [310

City of Birmingham. Annual Report of the Mental Hospitals Committee, April 1st, 1938, to March 31st, 1939. Pp. ii+32. (Birmingham: Mental Hospital.) [310

Transactions of the Royal Society of Edinburgh. Vol. 60, Part 1, No. 1: The Scottish Carboniferous Crinoidea. By James Wright. Pp. 78+12 plates. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 14s. 6d. [410

Ollsgoil na h'Éireann (The National University of Ireland). Calendar for the Year 1938. Pp. ix+336+648+426. (Dublin: National University of Ireland.) [410

Other Countries

Smithsonian Institution: Bureau of American Ethnology. Bulletin 124: Nootka and Quilente Music. By Frances Densmore. Pp. xxvi+358+24 plates. (Washington, D.C.: Government Printing Office.) 60 cents. [210

U.S. Department of the Interior: Office of Education. Bulletin 1938, No. 10: Local School Unit Organization in Ten States. By Henry F. Alves, Archibald W. Anderson and John Guy Fowlkes. (Local School Units Project.) Pp. xi+334. (Washington, D.C.: Government Printing Office.) 40 cents. [210

University of Illinois: Engineering Experiment Station. Bulletin No. 312: An Investigation of Wrought Steel Railway Car Wheels. Part 1: Tests of Strength Properties of Wrought Steel Car Wheels. By Prof. Thomas J. Dolan and Rex L. Brown. Pp. 68. 70 cents. Bulletin No. 313: Tests of Plaster-Model Slabs subjected to Concentrated Loads. By Nathan M. Newmark and Henry A. Lepper, Jr. Pp. 54. 60 cents. Bulletin No. 314: Tests of Reinforced Concrete Slabs subjected to Concentrated Loads. By Prof. Frank E. Richart and Ralph W. Kluge. Pp. 76. 80 cents. Bulletin No. 315: Moments in Simple Span Bridge Slabs with Stiffened Edges. By Prof. Vernon P. Jensen. Pp. 106. 1 dollar. Reprint No. 13: First Progress Report of the Joint Investigation of Continuous Welded Rail. By Herbert F. Moore. Pp. 30. 15 cents. Reprint No. 14: Fifth Progress Report of the Joint Investigation of Fissures in Railroad Rails. By Herbert F. Moore. Pp. 34. 15 cents. (Urbana, Ill.: University of Illinois.) [210

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 26, No. 3 (Mathematics No. 40): Beiträge zur Geometrie der Kreise und Kugeln (32). Von Sôzi Matumura. Pp. 89–134. Vol. 26, No. 4 (Mathematics No. 41): Beiträge zur Geometrie der Kreise und Kugeln (33). Von Sôzi Matumura. Pp. 135–178. (Taihoku: Taihoku Imperial University.) [210

U.S. Department of Agriculture. Miscellaneous Publication No. 344: Taxonomy of some Scale Insects of the Genus *Parlatoria* encountered in Plant Quarantine Inspection Work. By Harold Morrison. Pp. 34+11 plates. 10 cents. Technical Bulletin No. 689: Status and Relative Importance of the Parasites of the Hessian Fly in the Atlantic States. By C. C. Hill, J. S. Pinckney and E. J. Udine. Pp. 16. 5 cents. (Washington, D.C.: Government Printing Office.) [410

Annals of the Royal Botanic Garden, Calcutta. Vol. 14, Part 2: An Account of the Genus *Dioscorea* in the East. Part 2: The Species which twine to the Right; with Addenda to Part 1, and a Summary. By D. Prain and I. H. Burkill. Pp. 425–528. (Alipore: Bengal Government Press.) [410

Catalogues

A Catalogue of English and Foreign Books and Periodicals on Pure and Applied Mathematics, Physics, etc. (No. 492.) Pp. 38. (Cambridge: Bowes and Bowes.)

Abridged List of Microscopical Preparations: Botany, Zoology, Histology, Bacteria, Diatoms, Textile Fibres, Rock Sections. Pp. 19. (Manchester: Flatters and Garnett, Ltd.)